THE

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THE

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1899

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STORAGE BATTERY INVENTIONS.

THE motor car movement has greatly stimulated the efforts of inventors to produce a storage battery of great capacity per unit of weight, and not a few batteries have been put on the market professing to be of much less weight for equal output than the older forms. An examination of these new batteries and of the specifications reveals the fact that the inventors have not succeeded in making any departure from the essentials of the Faure or Planté cells, lead and lead salts alone being successfully used. The plates consist of lead salts held in or upon a lead grid or electrode.

In stationary batteries there are no objections to constructing the grids substantially enough to perform the two functions of supporting the active materials and collecting the current therefrom, thus producing cells of considerable weight, 6 or 7 watt-hours per pound weight of battery being a fair result in capacity. Such batteries are well understood and are durable and reliable, but for successful traction work batteries of such weight are not suitable.

Most inventors endeavour to reduce the weight by increasing the proportion of lead salts to the weight of the grid; in heavy batteries we may find the lead grid equal to twice the weight of lead salts used in making up the plates, while in some recent cells we find it claimed that the grid is only half the weight of the salts.

So long as lead is used in batteries, the only invention possible is in the direction of reducing the mass of lead in the cell, sufficient being left simply to collect the current. The supporting of the active materials being no longer trusted to the grid, the inventor then devises supports of ebonite, glass, acid-proof paper, and other materials, much lighter than lead, which are applied in two different ways.

One uses a grid of vertical lead wires threaded through horizontal strips of ebonite, forming shelves, which carry the active materials and support them. Another takes glass rods as a weft interwoven with lead wires, the glass giving stiffness and resilience to the plates. A third employs very light perforated grids, and supports them by plates of light acid-proof paper, also perforated. Others prefer envelopes of celluloid or ebonite to hold the paste on extremely thin grids.

In all this there is not much invention. Still, if by some means a battery of great capacity and small weight can be produced, it is worthy of a patent.

It is claimed for some of these cells that 15 to 16 watt-hours per lb. of battery, at a discharge rate of 1 ampere per lb. of battery, has been obtained. We have failed, however, to find any independent confirmation of a capacity in any battery exceeding 10 to 11 watt-hours per lb. We are convinced that all these high-capacity light-weight cells will require very frequent renewal of plates; the negatives rapidly decline in capacity in continuous work, and the positive

grids soon corrode right through, the internal resistance increasing as these changes go on.

The renewal of cheap plates as soon as the capacity falls below a certain amount should be provided for in all battery traction projects, renewals forming a large part of the cost of battery traction. Plates which were expensive to renew would be no improvement over cheap plates of the same capacity.

In judging traction batteries, it is not, therefore, sufficient to find the capacity per lb. weight only. It is necessary to find how long that capacity is maintained in continuous working. Say, a battery starts with a capacity of 12 watt-hours per lb., how many full charges and discharges will it stand before the capacity falls to 10 watt-hours per lb., and what will be the cost of renewal? These questions are rarely answered in descriptions of new cells.

In connection with road traction by batteries, we find that most vehicles for that purpose carry 80-volt batteries. Why 80 volts? We have never been able to find out the reason for this singular voltage; why not use larger cells and fewer of them?

The battery is so near the motor, that loss in the leads is negligible. As only 100 to 120-volt circuits can be used for charging 80-volt batteries, probably 80 volts was selected in the days when 110 volts was the usual pressure; but nowadays 200 to 250 is becoming so common, that batteries to be used on supply from street mains must be raised to 160, 180, or 200 volts pressure, although small cells do not give quite as high a capacity per lb. as larger ones.

On the whole, inventors have not much room for improvements in lead cells. When they have reduced the grid to a minimum, and supported the active materials by something lighter than lead, their efforts are exhausted, and a possible capacity of about 14 watt-hours per lb. is obtained for a time.

Competition in Electricity Supply.

The question of municipalisation of the electricity works is receiving consideration at Ottawa, Canada, at the present moment. The purchase of the company's plant, goodwill, &c., has been suggested at about £250,000. We do not know the terms of the company's concession (presumably it has one), but looking at the matter afar off it is somewhat unfair that a scheme should be produced for the municipality to put down "a brand new up-to-date plant, including water-power and buildings, transmission facilities, and all other necessary adjuncts for the sum of £100,000, which is £150,000 less than the company asks for an antiquated plant." A certain alderman comes forward with this proposal, to carry which into effect he says he can find the capital in New York if the Council concludes to go into the lighting business. The advanced municipal characteristic of unfairness seems not to be confined to English local authorities. Favourably disposed as is our Parliament toward municipalisation of public works, it would not favour the establishment of a competitive service unless the owners of a concession had very signally failed to fulfil the terms of the agreements entered into. Our own large power schemes, for which there is far greater justification than for ordinary lighting competition, have been disallowed because of their possible injury to municipal interests, and if the same justice is to be meted out to both sides, we ought not to allow a municipality anywhere in this country to compete unjustly with an existing company which has borne the burden and heat of the day. Bad as some of our municipalities may be, we hardly think they would be guilty of adopting so unworthy a procedure; but even if they were to do so the Board of Trade and Parliament would doubtless not grant the competitive powers unless there were very exceptional reasons for doing so. In the City of London competitive powers have been granted to a company for reasons which have been repeatedly stated in our own and other columns, but there have lately been feelings that the intending competitor may not have such a bed of roses as was earlier supposed would be the case. That the present company is playing its cards well so far as reduced charges, &c., are concerned, there is not the least doubt, and its growing continuous current system gives it an additional weapon wherewith to wage war if it ever comes to that. All efforts of this kind put forth in the interests of consumers are perfectly justifiable as a means for gathering all the city into the Bankside net while the course is clear. The future line of action of the competitive company is not at present known. Some reports say that the company is jubilant and certain of success, while others hint that the powers may never be carried into effect at all. There is a danger that the present progressive policy of the City Company may be considered to be only a temporary one with a view to forcing the other party to relinquish its order, and that in the event of that coming to pass the City Company would revert to its shell again. We cannot see that such a policy would be to the advantage of anybody after all that has been said and done in connection with this matter, and we believe that the recent progressive action of the City Company will bring such a reward that the company will not be desirous of reverting to the higher charges, whatever may come to pass under the head of competition.

Electric Tramway Mishaps.

It is necessary to emphasise our recent comments on this question, for every week now there are quite a number of more or less serious accidents reported from different provincial towns. The public is not likely to forget that it has been informed by experts that an electric tramcar is the easiest thing in the world to control, that it can be stopped within its own length, and that the likelihood of accidents occurring has been exaggerated. In the interests of electric traction it ought to be stated that some recent instances of speedy stoppage are on record which would hardly have been possible with any other traction system, and trespassing pedestrians have marvellously escaped being run over; but on the other hand, we cannot help regretting that so many collisions with other traffic are occurring. We suppose a certain time should be allowed for the ordinary traffic to get used to the new tram system, and as with the automobile, too high a speed ought not to be permitted until such an opportunity has been afforded. We do not know whether car drivers are culpable in any of the recent cases, or whether opposition traffic has caused obstruction as frequently happens where an up-to-date competition in traffic facilities is introduced, but tramway managers ought to warn their employés to exercise the greatest caution and not give way to recklessness through the novelty of their position. The questions of control and speed appear to have been outside the scope of the recent Board of Trade inquiry at Dublin; but if there are many more accidents, particularly of the kind reported this week from Liverpool, we may expect the Board of Trade to make investigations into the whole question. A reduction in permissible speed is quite undesirable, for a locality does not take very long to get used to the conditions of electric traction, but too ambitious a speed at first may not be altogether a blessing from the point of view of the spread of rapid electrical transit.

MEASUREMENT OF THE INTERNAL RESISTANCE OF ACCUMULATORS.

By E. C. RIMINGTON.

It is well known that to obtain with a fair degree of accuracy the internal resistance of an accumulator is a matter of considerable difficulty, and unless proper precautions are taken the result may easily be wrong by several hundred per cent.

The writer has lately had occasion to accurately determine the internal resistance of an accumulator whose value was about 0·005 ohm.

The first method employed is shown in fig. 1. The cell

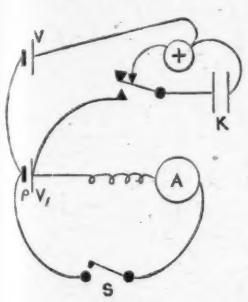


Fig. 1.

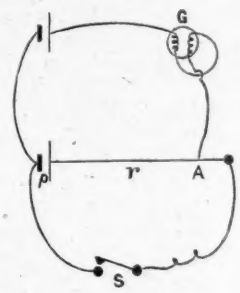


Fig. 2.

to be tested is circuited through a resistance, an ammeter A, and a switch S. A similar cell is connected as shown, and arranged with a condenser, K, and a galvanometer to read the potential difference between the points V and V_1, the value of the throw in volts being determined by obtaining the throw from a Clark or Carhart standard cell. Instead of the condenser and galvanometer, a galvanometer shunted and put in series with a resistance so as to act as a voltmeter may be employed.

The current, C, is read on the ammeter, then if P be the potential difference of the cell under test, E its E.M.F., and ρ its internal resistance—

$$\rho = \frac{E - P}{C}.$$

Now, the E.M.F. of the auxiliary cell is also E, hence $E - P = V - V_1$, and is obtained from the throw on the galvanometer. This method would give accurate results if the E.M.F. of the cell under test remained the same when giving the current, C, as when an open circuit, but unfortunately even with accumulators, there is a slight falling-off of E.M.F. due to polarisation. Now, this lowering of E.M.F. may make a very considerable difference in the value of $E - P$, since P will not be very much less than E. Suppose when the current is C the E.M.F. of the cell under test to become $E - e$. Then the true value of

$$\rho = \frac{E - e - P}{C} = \frac{E - P}{C} - \frac{e}{C}.$$

That is, it equals $\rho^1 - \frac{e}{C}$ where ρ^1 is the value obtained in the supposition of no polarisation. So that ρ^1 is always larger than ρ the real value. A better result may be obtained in the following manner: after having observed the throw due to $E - P$, depress the key so as to charge the condenser, break the circuit by the switch and at once let up the key, this will give a throw due to $E - (E - e)$, or e, subtract this throw from the first and we shall obtain the throw due to $E - e - P$, find the value of the throw in volts and divide by the current. The result will be considerably nearer the true value of ρ, but probably still rather higher than the true value, as the instant the switch is broken the E.M.F. begins to recover from polarisation. In the above, as the throw from the standard cell will be much higher than either of the throws for the test, it will be advisable to use enough capacity to make the throw due to $E - P$ as large as the scale will allow, and shunt the galvanometer with an Ayrton and Mather universal shunt, using a multiplying power for the standard cell.

The above suggests a method of dispensing with the ammeter and turning a deflection into a balance or zero method.

The connections are as in fig. 2, G is a fairly high resistance differential galvanometer and r an adjustable resistance, it may with advantage be a stretched piece of platinoid wire, A being a slider moving on it. Obviously, if G represents the resistance of each coil of the differential galvanometer, the current through one coil is $\frac{E - P}{G}$, and that through the other $\frac{C r}{G}$, and as there is no deflection

$$\frac{E - P}{G} = \frac{C r}{G}, \quad \text{or} \quad r = \frac{E - P}{C} = \rho.$$

Again, the error due to polarisation is present, since the conditions of a balance are $E - P = C r$, while the real value of ρ is

$$\rho = \frac{E - e - P}{C} = r - \frac{e}{C}$$

so that the true value of ρ will be less than the value obtained on the supposition of no polarisation.* As a differential galvanometer may generally be replaced by an ordinary galvanometer and a Wheatstone bridge arrangement, the above method leads to the following, shown in fig. 3.

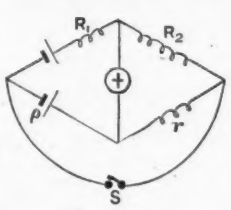


Fig. 3.

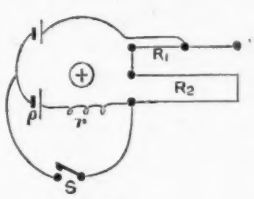


Fig. 4.

R_1 and R_2 are resistances, R_1 must be high enough to allow of the internal resistance of the auxiliary cell in series with it being neglected, about 10^{ω} will be found a convenient value; R_2 will in general be greater than R_1 and should be capable of adjustment, r is a resistance of thick wire capable of carrying the current that the cell gives in its normal discharge, it may conveniently be about 10 times the resistance of ρ.

Adjust R_2 until there is no deflection on the galvanometer† when the switch is closed, then if the E.M.Fs. remain the same

$$\frac{\rho}{r} = \frac{R_1}{R_2}, \quad \text{or} \quad \rho = r \cdot \frac{R_1}{R_2}$$

by the principles of the bridge. The effect of polarisation will, however, be similar to its effect in the differential galvanometer method, and make the apparent value of ρ greater than its real value. Thus by Kirchhoff's laws calculate the current through the galvanometer due to each E.M.F. separately, the other being supposed zero, the real current will be the difference between these when both E.M.Fs. act simultaneously. Calling the E.M.F. of the auxiliary cell E, and that of the cell under test $E - e$, we have current in galvanometer

$$= \frac{E\{F(r + R_2) + R_2(\rho + r)\} - (E - e)\{F(R_2 + r) + r(R_1 + R_2)\}}{\Delta}$$

The denominator Δ being composed of terms involving all the resistances, but whose value it is unnecessary to determine for the present purpose. F is the resistance of the branch containing the switch.

Now, if the current in the galvanometer is zero the numerator must be zero, and this gives

$$\rho = r\frac{R_1}{R_2} - \frac{e}{E}\left\{F\left(1 + \frac{r}{R_2}\right) + r\left(1 + \frac{R_1}{R_2}\right)\right\}.$$

So it is seen that ρ is less than its apparent value by an amount that depends on e, the loss of E.M.F. due to polarisation.

* The term $\frac{e}{C}$ cannot be much reduced by making C large as e will be a function of C, increasing as c increases.

† There should be a key in the galvanometer branch.

If now, however, this method is worked in a similar way to Mance's method, of which it is obviously a modification, we can eliminate the effects of polarisation and obtain accurately the real value of ρ.

Having connected up as shown in fig. 3, the switch, S, being open, there will probably be a small deflection in the galvanometer due to the two E.M.Fs. not being exactly equal in value. On closing the switch a large deflection will be probably obtained either to the right or left; by altering R_2 it can be found whether this deflection means R_2 is too high or too low, and R_2 must be adjusted until the deflection is the same whether S is open or shut, or rather until this would be the case if there were no polarisation.

Suppose R_2 to be thus adjusted, let us consider what will happen if the cell being tested polarises. On the instant of closing the switch the galvanometer index will move in a direction showing a downward current through the galvanometer in the figure, since the E.M.F. of the cell to be tested diminishes. Now, it will be found that if R_2 be diminished, the effect is to produce a deflection in the opposite direction to that due to polarisation. Hence, R_2 must be diminished until a kick in this direction is produced, this kick will be immediately followed by the movement of the index in the opposite direction, due to polarisation, as the switch is kept closed. R_2 must now be gradually increased until this kick in closing the switch *just* disappears, and this value of R_2 will be the correct one to use in the formula

$$\rho = \frac{R_1}{R_2} \cdot r.$$

This method, as before stated, is a modification of Mance's test, by putting a balancing E.M.F. in one of the arms, this E.M.F. being in series with a resistance high enough to make its internal resistance negligible. It will be found, however, greatly superior to Mance's as regards ease of working, as the galvanometer is worked near to its real zero instead of to a very large false zero, only to be obtained by strong controlling magnets; and, moreover, a sensitive d'Arsonval galvanometer can be employed, which could not be done with Mance's method except by a large twisting of the torsion head to the great detriment of the instrument.

Fig. 4 shows the actual connections, the resistance r, is preferably wound non-inductively and must be of large enough wire to carry the current that goes through it when the switch, S, is closed. R_1 is one of the ratio arms of a Wheatstone bridge, and R_2 the adjustable arm of same. The reason why all the resistances should be non-inductive is that the kick on the galvanometer due to R_2 being too small, would be confused by a kick due to self-induction, if any of the resistances were wound inductively.

In the case of a test made by the writer, $R_1 = 10^{\omega}$, $r = \cdot086^{\omega}$ of No. 10 platinoid wire, and a balance was obtained when $R^2 = 185^{\omega}$, giving

$$\rho = \frac{10}{185} \times \cdot086 = \cdot0046^{\omega}.$$

The current given by the cell when the switch was closed would be about 15 amperes, and when open practically nothing.

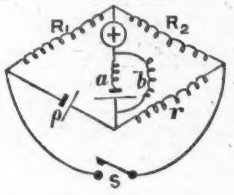


Fig. 5.

The galvanometer used was a sensitive d'Arsonval of the N.C.S. latest pattern, with an Ayrton & Mather universal shunt (total resistance $10{,}000^{\omega}$) on it, the shunt switch being at multiplying power 10; the whole is in series with $10{,}000^{\omega}$.

Another modification which would probably work nearly, if not quite as well, is shown in fig. 5. The shunt, b, on the auxiliary cell, is to be adjusted until the deflection on the galvanometer is practically *nil* when the switch is open, a resistance, a, is put in series with the cell before shunting it to increase its internal resistance, and allow its apparent E.M.F. to be diminished easily without using a shunt of very low resistance. The working of this method will be exactly the same as that last described, and, of course, as before

$$\rho = r. \frac{R_1}{R_2}.$$

ELECTROGRAPHS, MADE WITHOUT A CAMERA, OF THE ELECTROSTATIC CURRENT.*

By Prof. ELMER GATES.

During a recent storm here in Washington several men took shelter near some trees, and the bench upon which they sat was struck by lightning. One of the men afterwards found upon his body what he called the "picture of a tree."

Fig. 1.—An Electrograph.

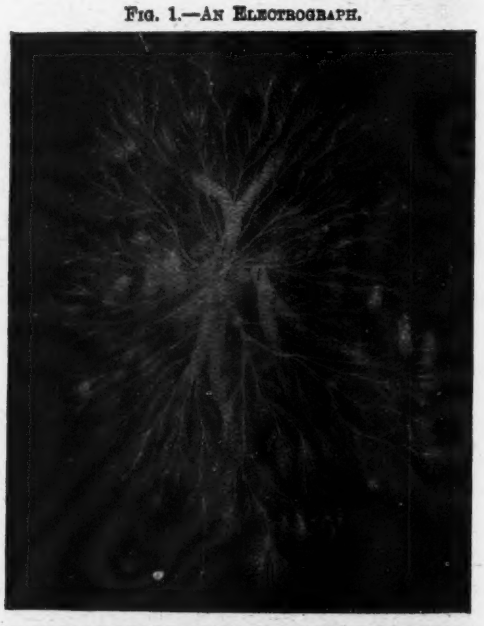


Fig. 2.—First Experiment.

People in speaking about it, and newspapers in writing about it, spoke of it as a photograph of a tree made on his body by lightning. An examination of the photographs of the electric spark herewith presented will make it evident that

* *Scientific American.*

it was not a picture of a tree which was found upon his body, but a picture of the path taken by the current in spreading over the surface and through the skin. This popular belief that the lightning photographs a tree upon the body of a person struck by a current must, therefore, be abandoned.

I had often photographed the spark—and brush—discharge by means of a camera, but it recently occurred to me to try the action of the spark and current of a frictional machine directly upon the sensitive film under such conditions as would enable me to determine certain facts about the path of the current through a conductive surface. Accordingly I placed a 14 × 17 Cramer isochromatic plate in between the two poles of my 10-plate 32-inch static machine while in full action, and directed the spark directly against the sensitive plate placed within a light-proof envelope, thus allowing the current to photograph its path through the film. The machine was made to run at such speed as to give a rapid succession of sparks at about half its full sparking distance. Then the knobs were drawn farther apart until, at the speed at which the machine was running the sparking ceased, and in its place there occurred a brush discharge. The envelope-covered sensitive plate was then placed vertically between the poles, transversely across the path of the spark, and nearer to the negative than to the positive pole, with the film side toward the positive pole. The positive terminal was then moved toward the sensitive plate until one spark passed, and then quickly drawn back so as to prevent the machine from delivering a second spark. The plate, on being developed, showed in a most interesting manner and in its natural size the path of the current. The sensitive film is a much better conductor than the glass upon which it is placed, the latter being one of the best non-conductors. Hence the current spreads through the film instead of going through the glass, and leaves traces of its path by depositing the silver that lies in its course. In fig. 1 the spot where the spark struck the plate is shown at *x*, from thence the current diverges in all directions, like the branches of a tree; the branches diverge into twigs, the twigs into leaflets, the leaflets into filaments, and so on, with indescribable complexity of detail. Every part of the current seemingly tends to get farther away from every other part of itself, but this would be a wrong interpretation of the phenomenon. As is well known, when two currents of electricity pass near each other, and in the same direction, they mutually attract each other. It follows, therefore, that the branching of the current, as shown in the picture, is not due to any repulsion between parts of itself, but to its tendency to take paths of least resistance in going through a conductor. The film on the glass plate

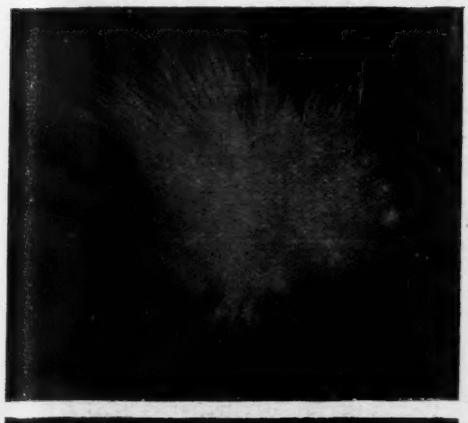


Fig. 3.

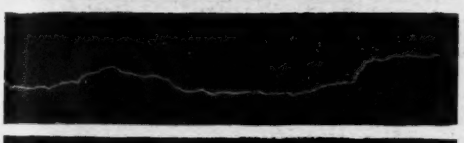


Fig. 4.

Fig. 5.

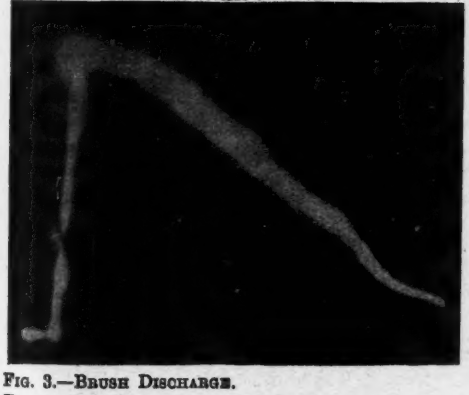


Fig. 6.

Fig. 3.—Brush Discharge.
Fig. 4.—Discharge in Air.
Fig. 5.—Multiple Discharge between Terminals.
Fig. 6.—Discharge around Rubber Plate, Photographed with Camera.

Fig. 7.—Discharge on Plate between Shellacked Glass Plates.

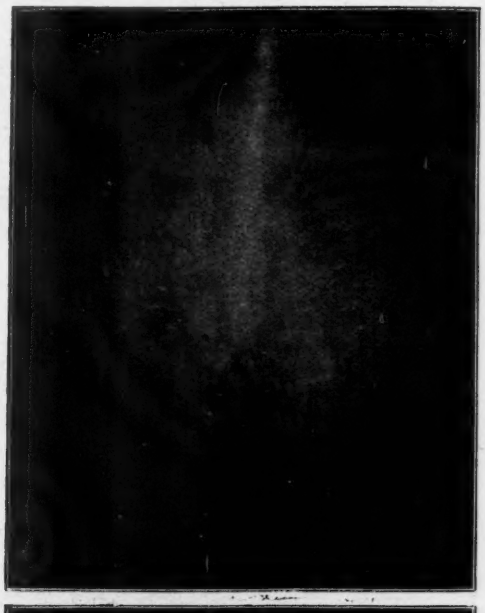


Fig. 8.—Sensitive Plate placed between Shellacked Plates.

is a conductor, but the glass is not. A conductor has less resistance in proportion as its cross-section is larger, and more resistance as its cross-section is smaller. It is evident that where the spark strikes, the film has but little area of cross-section as compared to the larger concentric surface toward which it spreads. The spark on striking the film first touches a small spot, as at x, and thence it spreads in all directions radially outward from that spot, because the farther it gets away from the spot, the larger the cross-section of the film through which it travels, and consequently the less the resistance. If you use spot x as the centre, and circumscribe a circle 1 inch in diameter, and a concentric circle 2 inches in diameter, you will understand that when the current has reached, in its radially outward course, the limits of the outer circle, it will be traversing a greater cross-section of the film than when it was at the inner circle. From any given point in a concentric circle around the spot first struck by the spark, the direction of least resistance for the current is radially outward. This is why the current splits up into so many branches, and these again into smaller branches, and so on. But the mutual attraction of currents going in the same direction also influences the branching process. The abrupt changes in direction in any one of these branches can doubtless be attributed to local differences of resistance in the film itself.

Fig. 9.—Discharge on Celluloid Film.

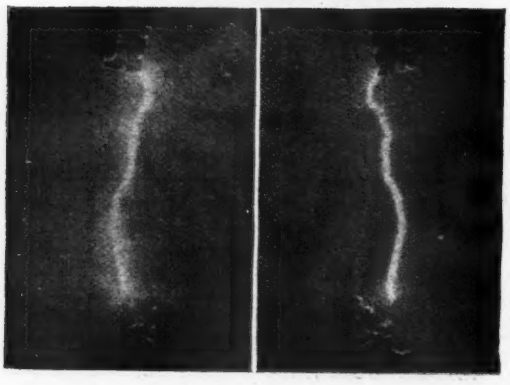


Fig. 10. Fig. 11.

Discharge between Plates facing each other.

The branching paths of the current in the film are not due to areas or lines of conductive substances scattered throughout the film and having less specific resistance than the rest of the film, but to the fact that the conductor grows larger in cross-section most rapidly when the current goes radially outward in all directions, thus making the path of constantly lessening resistance.

In several places branches may be seen approaching each other and uniting thereafter; but sometimes they cross each others' paths without uniting. In the latter case I judge that one of the currents had passed before the other one had arrived. The current in passing over the film precipitates the silver, and the result is a picture of its path made by the spark itself, and without a camera! When the current strikes the centre of the film, as at x, it tends to spread equally in all directions radially outward, and if the sensitive film had uniformly the same specific conductivity throughout its whole surface and substance the current would still divide up into branches and twigs, because of the fact that radial lines of current would still be produced by paths of least resistance, and these paths would be radially outward. If the spark would strike the plate in the exact centre, if the plate were exactly transverse to the path of the current, and if the film had a uniform resistance in all parts of itself, we may believe that the picture of a spark made by itself would be symmetrical in its branchings. But differences of resistance in the film would destroy this symmetry, and render the paths crooked, as is shown in some of the branches of fig. 1. In some of the figures the spark was not wholly conducted by the film; hence it jumped over the top of the plate, leaving a broad white path produced by the light of the spark and a branching figure produced by the current. Fig. 2 is the first electrograph the writer ever made, and it is quite interesting. It shows how one spark, x, went wholly around the plate, and how another spark divided, part going around the plate, leaving a light effect in the shape of a white streak, and part being conducted through the film, leaving a beautifully branched tracing of its path.

When the knobs are too far apart to permit sparking, the result is a brush-discharge, and when a sensitive plate is held vertically therein, the result is as shown in fig. 3.

We sometimes hear it asserted that the course of lightning is not crooked, but straight, and that the crooked appearance is due to the irregular background of clouds. That such is probably not the case is shown in figs. 4 and 5, natural size, made of sparks 16 inches long, with a camera using a Zeiss 12 × 15 anastigmatic lens. In fig. 4, at o, is shown a portion of the current separating from itself. It is evident that an electric current through the air takes a crooked course.

Fig. 6, made with a camera, shows the spark passing around a rubber disc, thus taking a much longer course through the air in preference to going through hard rubber, which is a much poorer conductor than air. The spark is seen to go straight to the centre of the disc, which was held vertically between the poles, straight up to the vertical edge of the disc and parallel to its surface, around the upper edge, and then taking a straight path for the other pole. This gives an idea of the tendency of the current to follow paths of least resistance; the current went almost twice the distance through the air in order to avoid going through a $\frac{1}{16}$th inch thickness of hard rubber.

In figs. 7 and 8, I placed the sensitive plate between two glass plates coated with shellac, and allowed the current to enter through the centre of one of the plates by means of a small hole in which a metal conductor was placed. Thus, allowing the spark to strike the centre of the sensitive plate, on the film side, and thence to spread radially outward toward a circumference of tin-foil placed on the outer edge of the same plate, through which the hole was made. The effect of thus confining the film between two glass plates is quite unexpected—the appearance is characteristically different from that of all the other photographs herewith sent, and I do not attempt to explain the strange marble appearances in the picture. Fig. 9 is also most interesting. The picture was made by making a cylinder an inch in diameter out of a sensitive film such as used in a kodak with the film side outward. A strip of tin-foil was then rolled over the ends of this cylinder so as to cover the film for the distance of an inch from either end. Around this cylinder was rolled another strip of sensitive film with the sensitive surface inward; and around this was rolled light-proof paper. The roll was then held lengthwise between the knobs of the static machine and a single spark was allowed to pass. Figs. 10 and 11 were made by placing the ends of metallic conductors between two sensitive plates with the film sides facing each other.

When a plate is placed within a light-proof envelope there is a comparative absence of the marble effect which is found

when the film is between two good non-conducting surfaces.

The peculiar interest that attaches to these pictures is that they are not photographs, but electrographs. These pictures, except 4, 5, and 6, were made by the direct action of the electric current, and not by the light of the current. The light effects are the broad white streaks, but the branching effects are due to the direct action of the electrostatic current.

THE MECHANISM OF THE WEHNELT INTERRUPTOR.

A painstaking investigation by Voller and Walter in *Wiedemann's Annalen*, Vol. 68, p. 526, goes a long way towards explaining the various processes, physical and electrochemical, to which the remarkable action of the Wehnelt break is due. It certainly disposes, once for all, of certain favourite theories that have been advanced by some of our great authorities.

What led to the investigation was an observation by Walter that the flames about the anode, when the break was working, gave a very decided hydrogen spectrum. The occurrence of hydrogen at the anode would, of course, be impossible in normal electrolysis. In order to make certain whether hydrogen was present in any considerable quantity, the gases from the anode were collected in a tube and tested; when both hydrogen and oxygen were found to be present in proportions varying considerably according to circumstances.

We shall not describe in detail the apparatus used by Voller and Walter. It will be sufficient to say that the electrodes of the Wehnelt cell were so arranged, that the gases could easily be collected from either of them in explosion tubes. The primary coil of a 30-cm. Kohl induction coil was placed in circuit with the Wehnelt. This coil could be removed from its own secondary, and placed in the secondary of a 50-cm. Kohl. The discharge of sparks was found to be much stronger in the second case, showing, what has been already noted, that, to get the best results with a Wehnelt, the relative proportions of the primary and secondary must be very different from those that are best in the ordinary induction coil.

The gas collected from the anode of the Wehnelt was always found to be an explosive mixture of oxygen and hydrogen. The relative quantities of the exploded and the residual gases varied considerably in different experiments. The proportions changed not only with the length of the anode wire and the strength of the applied current, but also with the magnitude of the inductance of the primary coil in circuit. The greatest difference was found between the results when the primary coil was lying free on the table, and when it was inserted in the largest secondary coil. For example, in the latter case, 45·5 ccm. of anode gas left, after explosion, a residue of 37·4 ccm., while in the former case, *ceteris paribus*, 51 ccm. of anode gas left a residue of 10·8 ccm.

On the assumption than the anode gas consisted entirely of a mixture of oxygen and hydrogen, and that after the explosion pure oxygen only was left, it is easy to calculate from the above figures that, in the first case, the anode gas contained 11·9 per cent. of hydrogen, and in the second case 52·6 per cent. The above percentages can only be looked upon as approximate, since the residual gas, when tested, was found to contain 2 or 3 per cent. of nitrogen derived from the gases dissolved in the electrolyte, and a considerable proportion of ozone was also found to be present. But the differences made by these corrections would not be great.

The anomalous presence of hydrogen in the anode gas of the Wehnelt cell might of course be due to the presence of oscillating currents. But if such were the case, a corresponding quantity of oxygen ought to be found in the cathode gas. To test this, a quantity of the cathode gas was collected. It was found to be non-explosive, but as this might have been due to oxygen being less than one-seventh of the total volume, a more direct test was applied. A quantity of the cathode gas was shaken up in a tube with an alkaline solution of pyrogallic acid. A very small percentage of oxygen gas was found in this way, but this was shown to be derived, like the nitrogen, from the gas dissolved in the electrolyte, by making a duplicate test with the wire anode replaced by a platinum plate anode. In the latter case the same percentage of oxygen was found in the cathode gas. These experiments completely upset the theory of the existence of oscillating currents in the Wehnelt cell.

It became thus highly probable that the anomalous electrolysis in the Wehnelt interruptor occurred only at the anode, and further observations on the volumes of gas evolved at the respective electrodes appeared to establish this beyond doubt. Suitable apparatus was arranged to collect and measure the gases evolved, and to measure at the same time the mean current strength. As an example, the data obtained from one such experiment are here given. The 50-cm. coil, with its own primary, was used in the experiment. The quantity of anode gas obtained was 441 ccm., of cathode gas 387 ccm., the mean current was 9·4 amperes, and the duration of the experiment 6 minutes. The quantities calculated by Faraday's law ought to be, at the anode 196 ccm. of oxygen, at the cathode 393 ccm. of hydrogen. The volume of the cathode gas, within the limits of accuracy here attainable, agrees with the theoretical quantity, while the volume of the anode gas is 2¼ as much as it ought be in the normal electrolysis.

It was found, moreover, that this excess of the volume of the anode gas depended very much on circumstances. As extreme cases, the results of two experiments may be given, in one of which the 30-cm. primary was placed first outside (free, on the table), and secondly, inside the 50-cm. secondary. In the first case the volume of the anode gas was 3·7 times as much as the theoretical amount; in the second case it was only 4 per cent. greater. But this second quantity of anode gas was by no means pure oxygen, but contained enough hydrogen to render it explosive. It was found, moreover, that in the first experiment the anode gas, besides its large quantity of hydrogen, contained 78 per cent. too much oxygen, and, in the second experiment, it contained 6·1 per cent. too little.

A simple demonstration that the anomalous electrolysis takes place entirely at the anode was obtained by placing in circuit with a Wehnelt cell a normal cell, the same in every respect, except that the wire anode was replaced by a platinum plate anode. The following were the volumes of gas obtained:—

	Normal cell.	Wehnelt cell.	Theoretical (calculated).
Anode ...	226 ccm.	475 ccm.	229 ccm.
Cathode ...	457 „	452 „	458 „

A comparison of these figures shows distinctly that the anomalous development of gas occurs at the anode of the Wehnelt only.

The authors tried some experiments to determine whether the anomalous electrolysis took place at the anode of the Wehnelt cell when the self-induction coil was removed from the circuit. This they found to be the case. There was not the same excessive volume of gas developed at the anode, but the anode gas was found to contain from 9 to 11 per cent. of hydrogen. The experiments were made by placing a normal cell in the same circuit as the Wehnelt cell, as in the experiment described above. The best results were obtained by using a high E.M.F. (216 volts).

By reversing the current in the Wehnelt cell, it was found that brilliant spectra of the metals forming the wire electrode (now the cathode) could be obtained. The lines of sodium and hydrogen were also found on the spectrum, but that was considered an advantage, as they formed useful datum lines. The platinum wire was replaced by wires of other metals, which all gave brilliant and characteristic spectra.

Having established the existence of anomalous electrolysis at the anode of the Wehnelt cell, and completely demolished the theory of the existence of oscillatory currents, Voller and Walter proceeded to determine the time curve of the current between two successive breaks or interruptions of the current. In passing, they point out that the existence of high E.M.Fs. in a circuit in shunt with the break is not peculiar to the Wehnelt break, but occurs equally in all breaks, as a consequence of the self-induction of the primary coil. As this experiment is chiefly relied upon by those who maintain the existence of oscillatory currents in the Wehnelt, they are brought face to face with the *reductio ad absurdum* that oscillatory currents must be produced by the ordinary break, even when a condenser is absent.

The rise of the current, after the circuit is made, follows exactly the same law in the Wehnelt as in the ordinary break. This is expressed by the well-known formula—

$$i = \frac{E}{R}\left(1 - e^{-\frac{R}{L}t}\right)$$

where i is the current at any time t, E is the applied electromotive force, R is the total resistance of the circuit, L its coefficient of self-induction, and e the base of natural logarithms. The curve representing the rise of the current is what is known as a logarithmic curve.

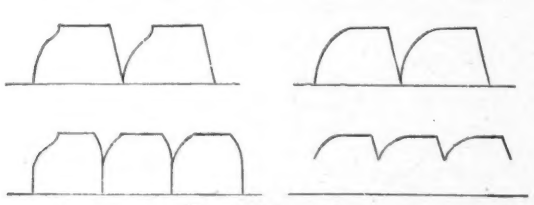
So far the action of the Wehnelt and the action of the ordinary mechanical break are identical. But one characteristic peculiar to the Wehnelt here comes in, namely, that the interruption in the Wehnelt cell always takes place when the make-current has reached a certain value which is greater, the greater the surface of the anode wire is. This fact is best demonstrated by gradually reducing a resistance in circuit with an inoperative Wehnelt, till it just begins to work. It will be found that this always takes place with the same current strength, and that this critical current strength is proportional to the surface of the anode wire exposed to the electrolyte.

The following explanation for this peculiar phenomenon is put forward by the authors. The layer of fluid in contact with the platinum wire has the highest specific resistance of any part of the circuit. The Joule heat (C^2 R) generated there will, therefore, produce the quickest rise of temperature, and convert the layer of fluid into steam. This layer of steam is then electrolysed or dissociated into a mixture of oxygen and hydrogen, which drives back the fluid electrolyte and breaks the circuit.

D'Arsonval has put forward the view that the envelope of steam around the platinum wire is generated by heat communicated from the wire to the surrounding liquid. But direct observation with the eye, and also with the spectroscope, proves that the platinum anode does not become white hot; the high temperature must, therefore, first arise in the liquid itself. Voller and Walter think that after the envelope of steam is formed, a discharge takes place across it of the same nature as the electric arc. But this point evidently requires further investigation.

Interesting results were obtained by the authors from an experimental investigation of the current time-gradient in a primary circuit containing a Wehnelt interruptor. The experiments were made by means of a Braun tube, in which the deflection of a fine stream of cathode rays is made use of to indicate the changes of the magnetic field and the primary current. The changes of the magnetism of the core were shown by placing the tube at right angles to the axis of the core. But since the magnetic field of the core is not a strictly accurate measure of the primary current, this was measured separately by another Braun tube placed at right angles to the axis of a solenoid in circuit with the primary coil.

By means of this apparatus, the time gradients of the primary current and of the magnetic field of the core were drawn. The results obtained are shown in figs. 1, 2, 3, and 4. Fig. 1 shows two cycles of the primary current when



Figs. 1, 2, 3, and 4.

there is no discharge between the terminals of the secondary coil, *i.e.*, the secondary coil has no more influence on the result than if it were not present. The steeper inclination of the curve, just before the current becomes constant, is probably due to the change of resistance caused by the formation of the envelope of steam round the platinum anode. What causes the current suddenly to become constant, and to remain so for about half of a complete cycle, is difficult to explain. Voller and Walter's view appears to be that electrolysis or dissociation of the steam is taking place. The final interruption of the current may be due, as in the electric arc, to over separation of the electrodes.

Fig. 3 shows the curve of the magnetism of the core, corresponding to the current curve fig. 1.

Fig. 2 shows the time gradient of the primary current when a discharge is taking place between the terminals of the secondary. The rising gradient of the current is steeper, on account of the reduction of the induction. The experiments described above showed that, in this case, a smaller volume of the mixed gases was given off. This appears to correspond to a shorter duration of the constant current.

Fig. 4 shows the variations of the magnetism of the core under the same conditions as in fig. 2.

It is evident that the falling gradient of the magnetic field, fig. 3, is steeper than in fig. 4, and experiment showed that the break tension in the first case was 200 volts, while in the second it was only 150. The authors think the greater volume of mixed gases liberated at the anode in the former case has something to do with this.

While the admirable investigation of Voller and Walter has thrown much light on the mechanism of the Wehnelt interruptor, much is still left to be explained.

ELECTRIC TRACTION IN THIS COUNTRY

We have a good deal of sympathy for the newspaper correspondent. Concealed behind a cloud of initials, or shrouded in the mystery of an unintelligible *nom de plume*, he thinks to move heaven and earth and all that in them is in favour of "movements," noble and ignoble. But he is doomed to disappointment, so cruelly are the fates against him; and particularly is that so if he has a real grievance to air, or a reasonable remedy to propound. Generally, we suppose, no one is any the better or much the worse for his perpetual flow of lucubrations, although an occasional check administered by those able to dispel a fallacy may have a healthy effect. Were one, however, to attempt to correct every erroneous impression that obtains currency regarding technical subjects, a special staff of shorthand writers and typists might be necessary. Now, "H. S. S.," whoever he may be, writes to the *Westminster Gazette* on the timely topic, electric traction. So many funny things have been said about this important matter, and have had the effect of hindering progress, that we do not care to allow the letter to pass unnoticed. The writer has visited Milan, Genoa, and Bâle, and praises sky-high what he has seen there, but, like many another Englishman, he seems to have admired the foreign glories before he has made himself acquainted with what is to be found in his "ain countrie," and he therefore returns home with a wrong notion of the relative positions of his own and other lands in the progress of civilisation. He contrasts the backwardness of this country in the matter of street electrical locomotion with Continental cities. He wants to know why "we laggards" can't go and do likewise, now that the problem has been solved for us years ago! He then shunts off on to another track, and grumbles at the hideous designs of motor cars, in which, for the most part, we agree with him, as also with his advocacy of "cleanly electricity" for their propulsion. He does not mince his words, for he is down upon "beastly steam" and "stinking petroleum," and then assuming the *rôle* of prophet, he says "there are millions in *the* electric motor carriage of the future." He advises some of the cycle companies, now in such low water, to turn their inventive powers in this direction, with a view to finding financial salvation! We pity the poor inventor of *the* electric carriage if he happens to come within the circle of *some* cycle companies or promoters. A broken down cycle company would be more likely to ruin the inventor and the electric carriage too, and the millions sterling would be—where? But as usual, the sting is in the tail, and the most important point of the letter is in the postscript: "Dover has set a good example at home with its excellent little electric tramline." It looks as though the writer had just discovered, after signing his letter "H. S. S.," that we are not completely "laggards," as Dover has a trolley system. Surely, everyone

has heard of the great success at Dover! He apparently knows nothing about the electric tram systems now operating at Liverpool, Glasgow, Sheffield, Bradford, Leeds, Dublin, Cork, Plymouth, Dudley, Ashton, Blackpool, Bristol, Hull, Kidderminster, and a number of other towns, and he is also apparently quite in the dark as to the enormous extension schemes, representing millions of pounds sterling, which are developing in nearly all of these places, as well as the score of other schemes which have arrived at the track construction and contract-placing stage. And above and beyond all these, he seems to know nothing of the recent decisions of the London County Council, whose backwardness, we suppose, is the real *raison d'être* of his epistle. His sin is a sin of ignorance, and his little learning is a dangerous thing. To understate the case is almost worse than exaggerating it in this instance.

To deplore the want of progress in electric traction work in this country was all right a short time ago, but anyone who has made a serious inquiry into the dimensions which such development has now assumed can hardly say that our movements during the past few months are "laggard." We drew attention to this matter in a "Note" last week, and we repeat that electric tramway work is now progressing at a most satisfactory rate. Whatever we may have done or left undone in the past, let us now profit to the fullest possible extent by the costly experiences of our foreign *confrères*, and see that the work we take in hand is done thoroughly and well. Better thus than to continue hugging ourselves in our disconsolate state, and shedding a lake of tears over what might, or even ought to, have been.

LONDON COUNTY COUNCIL.

The Council on Tuesday decided that, in consequence of the condition of the money market, the rate of interest on loans advanced to local authorities for electric lighting and other purposes shall in future be 3½ per cent., irrespective of the amounts. This decision will affect the £10,000 which it was resolved to lend the Whitechapel Board of Works for electric lighting purposes, but a proposal to advance £25,000 to the Fulham Vestry for similar purposes was referred back to the Finance Committee, in order to allow the Fulham members to place their views before the committee in regard to the increased rate of interest on this the second instalment of a total loan of £168,166 on this account.

The Appointment of Prof. Kennedy.

The special report of the Highways Committee, which was referred to in our last issue, was again brought forward in relation to the proposed agreement with Prof. Kennedy in connection with the electrical equipment of the Westminster Bridge-Tooting tramways between Rushey Green and the Crystal Palace, and between Camberwell and the tramway terminus at Vauxhall.

Mr. Melville Beachcroft asked the chairman of the Committee whether the Board of Trade had declined to grant a license to the Council to employ mechanical traction on the tramways. In reply, Mr. Benn stated that some dispute had arisen, but that he had had an interview with Sir Courtenay Boyle, and that the Board had promised to grant the license.

Colonel Ford contended that there was no indication in the Committee's report as to the time that would be occupied on the work.

Mr. Gilbert said that from a calculation he had made it was proposed to pay Prof. Kennedy about £30,000 in connection with 50 miles of line. That gentleman was an expert on electricity, but the speaker was not aware that he had constructed any tramways before. Continuing, Mr. Gilbert suggested that the Council should establish an electric tramways department and carry out the work on its own account, whilst a large amount of money would be saved if the tramways were put out to public tender.

Mr. J. W. Benn stated that that was no light undertaking, and that before being completed it would mean an expenditure of several millions of money for London. It was therefore necessary to obtain the best possible advice, and the Highways Committee sought the views of Sir Alexander Binnie, the Council's engineer. That gentleman expressed the opinion that it would be advisable to engage a separate engineer from the Council's staff, and he said that he knew of no more competent engineer than Prof. Kennedy. Having detailed what work the consulting engineer would have to carry out, the speaker stated that it was proposed that he should prepare drawings and specifications for each special case, and that tenders would then be invited and the whole of the contracts, if possible, placed in this country. Mr. Gilbert did not appear to know sufficient about Prof. Kennedy. Lord Russell was a member of the Highways Committee, and he had placed that gentleman's name at the top of his profession. Mr. Benn further stated that the committee had been careful to ascertain what name would be acceptable and bear weight with the Board of Trade. As to work carried out by the consulting engineer, Prof. Kennedy had acted as joint engineer with Mr. Galbraith for the Waterloo and City Railway, and he had also acted in conjunction with Prof. Unwin in regard to the electrical equipment of the Central London Railway; whilst he had also advised in connection with tramway alterations at Edinburgh, Ipswich, and other towns. The speaker considered that the Council would see that the committee had done their best to secure the best man for the work, and he hoped the Council would give the committee the competent advice for which they asked.

Mr. Balian proposed that the recommendation of the Committee should be referred back, in order that a maximum sum should be fixed, beyond which the Council should not go.

The amendment having been seconded by Colonel Ford, some further discussion ensued, when, on a show of hands, the amendment was rejected, only 16 hands being held up in favour of it. After a further amendment had been disposed, the report of the Committee was adopted by a large majority, deciding to enter into an agreement with Prof. Kennedy on the lines of the heads reproduced in this Journal last week.

Light Electric Railways.

After a long discussion, the Council resolved by a large majority to apply to the Light Railway Commissioners for an order to construct the following light railways, to be worked by electric traction:—

(*a*) From the present tramway terminus near the Archway Tavern, Archway Road to the county boundary. (*b*) No. 1.—From the present tramways at Clapham Common, south side, *viâ* Clapham Common, Battersea Rise, Wandsworth Common, north side, and East Hill, to West Hill; and No. 2.—From West Hill, *viâ* Kingston Lane, to the county boundary. (*d*) No. 1.—From the present tramways at Deptford, *viâ* Blackheath Hill and Road and Shooter's Hill Road to the Herbert Hospital; No. 2.—From the Herbert Hospital, *viâ* Woolwich Common Road, the road to the west of St. George's (Garrison) Church, into New Road, and thence along Thomas Street and Green's End, to and along three sides of Beresford Square, Woolwich, and returning along New Road, Mill Lane, and Woolwich Common Road to the Herbert Hospital. (*e*) From the present tramways at New Cross Road, *viâ* Lewisham High Road, Loampit Hill and Vale, Lee High Road and Eltham Road, to a point near Wellhall Lane at Eltham.

The Council also resolved to authorise the Highways Committee to take all the necessary steps in order to give effect to the application to the Light Railway Commissioners.

In connection with the proposed light railways, the Finance Committee submitted a special report on the financial bearings of the schemes. The Committee stated that—

On each of the lines a five-minute service would be run, although the manager of tramways is strongly of opinion that on some of the lines, or sections of them, a more frequent service will be required, and that the traffic receipts would average 11d. per mile run, and the working expenses 6d. per mile run, leaving a gross profit on working of 5d. per mile run. The present receipts over the whole system now worked by the Council average about 10½d. per mile, but this includes the omnibus takings, which are at a lower rate, and the unprofitable line from Camberwell to Vauxhall. Out of the estimated profit of 5d. per mile, the interest on, and sinking fund for the capital outlay, will have to be paid.

Electrical Legislation During 1899.

In the course of the report of the Parliamentary Committee showing the legislation affecting the Council in the session of 1899, reference is made to the following instances, together with the results which are worthy of being placed on record:—

Electric Power and Lighting Bills.

Central Electric Supply	Petitions presented in both Houses. Certain amendments as to accounts and other matters obtained. Bill passed.
County of London and Brush Provincial Electric Lighting Company, Limited	Petition presented. Council appeared by counsel. Bill rejected by Select Committee.
General Power Distributing Company (suspended from last session after passing House of Lords)	No action necessary. Bill rejected on second reading in House of Commons.
Kensington and Notting Hill Electric Lighting	Petition presented. Amendments adjusted. Bill passed.
St. James and Pall Mall Electric Lighting Company, Limited	Bill watched. No action necessary. Bill passed.
St. Marylebone Vestry Electric Lighting	Solicitor instructed to negotiate for amendments. Bill withdrawn before first reading.

Electric Lighting Provisional Orders.

Battersea and Fulham District ..	Not proceeded with.
Bermondsey	Included in Electric Lighting P.O. (No. 3) Bill and passed.
Bethnal Green Blackheath and Greenwich District (Extension)	Included in Electric Lighting P.O. (No. 15) Bill and passed.
City of London	Included in Electric Lighting P.O. (No. 20) Bill and passed.
City of London, St. Luke, Middlesex, Holborn City of London (East) City of London (South-East) Kensington Vestry	Not proceeded with.
Lewisham District	Included in Electric Lighting P.O. (No. 15) Bill and passed.
Metropolitan Electric Supply Company, Limited (City of London)	Not proceeded with.
Plumstead Vestry	Included in Electric Lighting P.O. (No. 15) Bill and passed.

Light Railway Orders.

Crystal Palace	Council resolved to oppose, but scheme withdrawn.
Finchley, Hendon and District Hampstead, Finchley and Edgware	Council appeared by counsel in opposition to schemes. Light Railway Commissioners refused to grant orders in consequence of opposition of local authorities.
Highgate, Finchley and Wood Green	Council resolved to oppose, but scheme not proceeded with.
London United Tramways (Extensions)	No action taken by Council. Order refused by Railway Commissioners.

THE SHOREDITCH INSTALLATION.

Discussion of the Annual Accounts.

The members of the Vestry at the meeting on Tuesday were occupied for over an hour in discussing the accounts of the electric light and refuse destructor undertaking for the year ended March 25th last. According to the accounts, there appears on paper to have been a deficit on the destructor of £3,616 during the year, and a paper profit of £5,632 on the lighting installation; but, if the former sum is deducted from the latter, the combined undertaking seems to show a surplus of £2,066 on paper.

Mr. N. Moss, chairman of the Lighting Committee, in moving the adoption of the accounts, said the Vestry ought to be congratulated upon having an accountant who had taken so much trouble to dissect the accounts and place almost every item, as far as possible, under the right headings. Perhaps most of the discussion would deal with the allocation of the large surplus, but he hoped that question would be left over for future consideration. It had been said to him that although a large surplus was shown certain matters ought to have been charged to the lighting department. There was a great deal that ought to have been credited to the undertaking which had not been. The enterprise was one of the finest for Shoreditch, and it mattered little whether it was from the lighting station or dust destructor, the fact remained that there was from the ratepayers' point of view a surplus down to the present of £6,463.

Major Wenborn, who seconded the motion, observed that unless the question of allocation was raised he did not see where the opposition would arise.

Mr. Smither asked where the £6,463 surplus was. Tradesmen taking stock and fancying they had so much money would rather have the money in the bank.

Mr. E. Adams (the accountant) referred the speaker to the general balance-sheet, showing, among other matters, stores at £549 and sundry debtors at £4,522, the latter money having now been received.

Mr. H. Winkler remarked that the whole parish had been misled by a statement made in some paper that a profit of £7,000 had been made, and the Vestry had also been misled by an assertion that if the undertaking had belonged to a company the latter would have paid 8 per cent. to the shareholders. That reminded him of certain financiers who manipulated figures and showed such a glorious success that poor people were suffering from their operations to this day. If they turned to the balance-sheet, it was found that the total loss on the refuse destructor for the year was £3,616, and the net profit on the electricity (trading) account was £4,415, and if the former was deducted from the latter the net profit of the two undertakings amounted to £799 for the past year. Let them, then, take the £6,463 mentioned by Mr. Moss as the total profit of the lighting station from the beginning, and compare it with the dust destructor figures as shown in the annual reports for the past two years. The losses on the latter amounted to £8,120, and by deducting the profit of £6,463, the net result was a loss to the parish of £1,657. Where was the glorious success? He hoped before long the loss would be converted into a profit, and that the expenditure in connection with the destructor would be largely reduced. In conclusion, he asked whether Mr. Adams could contradict any of the figures he had quoted.

The Accountant, in reply, stated that that was a correct statement of the figures of the combined undertaking in conjunction with the public lighting account.

Mr. H. E. Kershaw agreed with the last speaker that more profit would be realised if the expenses of the destructor could be diminished. He said that he had prepared a balance-sheet, and a few facts which it was impossible to give in the accounts. The profit of £6,400 was an inflated one, but he denied that there had been a loss of £1,657. With regard to the loss of £3,616 on the destructor, let them add to it the sum of £1,375 as the cost of coal, and then they arrived at the total expenditure for raising steam for various purposes. Out of that £5,000 the sum of £3,215 should be charged to the electric lighting account arrived at on the basis of ¾d. per unit sold; £536 was chargeable to the baths for steam and £100 to the library. Another point was that the scavenging department had saved 1s. per ton over the former cost of barging refuse, or £1,150, and the final result was that on the refuse destructor there was a profit of several pounds on the other side of his balance-sheet. There was an expenditure on electric lighting account, according to the accountant's figures, of £8,938, to which should be added £3,215 for the steam from the destructor, making a total of £12,153. The income from the sale of electricity was £16,417, which with £1,375 for coal made the total of £17,792. By deducting the former total from the latter they arrived at a gross profit of £5,538, which, after providing £2,146 for interest on debt and £916 for repayment of capital, showed an absolute trading account profit of £2,476 on the joint undertaking.

Mr. Adams, who asked permission to criticise the new balance-sheet, said that the figures submitted by Mr. Kershaw were a statement on paper. The facts which he had previously corroborated were taken from the printed accounts.

Mr. Howlett, who expressed the belief that the accountant's figures were perfectly correct, contended that the destructor was the real source of profit of the whole undertaking. It was about to place £1,317 in the Board of Trade return as the cost of coal when they had sold over 1,000,000 units, and he thought that the alleged loss on the destructor should have been charged to the lighting department.

Other members having spoken, Mr. Moss replied to the discussion. The chairman of the Lighting Committee stated that as he had anticipated, the discussion had turned on the allocation of the surplus. Mr. Hodder had said the committee desired to show a profit out of the work of other committees, but the speaker thought the destructor had not been fairly treated by other committees. Mr. Kershaw contended that the refuse was being burned at an economy of 1s. per ton over barging, but he found that as much as £2,100 should be credited to the destructor on that account, and that had not been done. The speaker was convinced that Mr. Winkler's figures were perfectly fallacious. No doubt there had been exaggerations, but the undertaking should not be allowed to suffer for that reason. If they went on in two opposite factions, he felt sure they would never get along at all. In conclusion, Mr. Moss expressed the opinion that the Vestry would have a very fine undertaking of lasting importance to the parish, and also be the means of assisting the rates in the future.

The adoption of the accounts then concluded the proceedings.

CORRESPONDENCE.

Electrical Transmission of Power in Factories.

Even Jove occasionally nods, and I venture, with the greatest deference, to suggest that the editorial mind cannot have been quite awake to the wiles of the "well-known maker" who is cited as an authority on page 582 of your issue of October 13th.

His quotation for a 4 H.P. motor at 300 revolutions per minute is £112; the actual price at which several other "well-known makers" supply this is somewhere in the neighbourhood of £67. Can it be that the well-known maker is among those who have been unsuccessful in the attempt to produce a satisfactory slow speed motor?

I would further suggest that in comparing the cost of a slow speed motor for direct connection, with that of a high speed motor driving the same shaft by belt, you should, to arrive at an accurate comparison, add to the price of the high speed motor the value of slide rails, belt, pulley on line shaft, and foundations (the latter not being usually required for direct connected motor).

You will then find that the cost of the high speed motor —accepting your figure of £43 for the motor itself — is about £50, or, say, £25 per cent. less than that of the slow speed motor.

Experience of large numbers of motors in use for long periods is as yet insufficient to show exactly what difference there is in the repairs required by the two classes, but it is certain, at least, that during the first few years the attention required by the slow speed motor is infinitesimal compared with that which is necessary to keep in good order the brushes, belt and lubrication of its high speed brother.

I have already intruded too far on your space to admit of mentioning more than one point further, namely, that experience of many hundreds of drum-wound motor armatures does not bear out the statement that drum winding is inferior to Gramme winding (both being, of course, in slots). The fact that drum-wound motors are produced by the great majority of manufacturers would seem to show that the principle of the survival of the fittest has asserted itself in this instance, as those of us who can remember the preponderance of Gramme armatures in the early days of motor work will agree.

Thanking you in advance for your kindness in affording space to the above.

Lente.

London, *October 16th.*

The Pneumatic Despatch.

In your issue of the 13th inst. referring to the working of the tube of the old Pneumatic Despatch Company, you quote an "extraordinary statement" that I am reported to have made, to the effect that "the inefficiency of the arrangements was such that no difference could be detected in the work done by the engine, whether the cars were running or not," and you go on to say that it would be interesting to know how I became possessed of the above information.

The actual statement to which you refer was that "the inefficiency of the arrangements was such that little or no difference could be detected in the work done by the engine, whether the cars were running or not," and my authority is a report by Mr. W. H. Barlow, who made a series of experi-

ments with the express object of ascertaining the conditions under which the pneumatic tube was working, and who had access to the results of experiments made by other observers.

In his report Mr. Barlow writes :—

"The remarkable feature of these experiments is that with the same number of revolutions per minute of the engine and the same pressure, a very large increase made in the load produces a comparatively small decrease in the speed.

"The most striking features exhibited by these experiments are, that whether the tube is closed at both ends (*i.e.*, Euston and G.P.O.), or closed at one end and a carrier inserted and fixed at the other, or whether a train is moving or not, and again whether each tube is put in connection with the fan at the same time, in all these cases there is little variation in the number of strokes required to maintain the given pressures."

Mr. Barlow's explanation of these phenomena was the inefficiency of the fan, and he states his opinion thus :—

"It was evident that so much of the work performed was due to the fan itself, that the difference of operating on one tube alone, or both together, did not produce a large effect on the work done by the engine."

What the conditions were under which, as you assert, the engine power was increased "as required," I must leave those who were present to explain, and to reconcile with the conditions of the experiments from which Mr. Barlow drew his conclusions.

Chas. A. Carus-Wilson.

October 16*th*, 1899.

[The problem stated in Prof. Carus-Wilson's last paragraph is so transparently easy that we can hardly take it seriously. Indeed, the quotations from Mr. Barlow's report themselves furnish the required explanation—with little credit, however, to Mr. Barlow's ability to interpret his experimental results. It is there stated that the engine was driving *a fan*, and that whether the tubes were closed, or a train in motion, the speed varied but little. No other result could be expected. An engine, controlled by a governor, will run at almost constant speed, whether loaded or unloaded; a fan of given construction, running at constant speed, will maintain a nearly constant pressure whether it is blowing into a closed chamber or propelling a train through a tube, but in the former case it will be running *idle*, absorbing but little power; in the latter case it will be running *loaded*, and will call for a corresponding driving power. The work done by the engine can only be judged by means of a transmission dynamometer, or by taking indicator diagrams. Who would dream of taking the speed as a criterion?

Mr. Barlow has apparently confused the action of a fan with that of a reciprocating air-pump—a totally different thing. His experiments, in fact, merely show that the governor of the engine was in good order!

The first quotation we may add is singular, in that "with the same number of revolutions per minute," there was "a small decrease in the speed"! This "remarkable feature" is to us an entirely new phenomenon.—Eds. Elec. Rev.]

"London's Lost Tunnel."

With some of the remarks made by way of Editorial Note in your last issue upon the subject of the old Pneumatic Despatch Tube (which you have seen fit to identify under the above title), I am in sympathy, but with others I am not.

So far as Prof. Carus-Wilson's statements are concerned, I leave that gentleman to defend both them and himself; but with regard to the clamour that has arisen over a journalistic phrase, which, curiously enough, you yourself deem worthy of repetition, though quoted, that agitation was none of my seeking, nor have I ever questioned the fact as I have often heard it said, "every engineer in the country knew of the existence of the tube, and all about it." Possibly they did; but seeing the amount of public interest awakened by the "re-discovery," as it is called, it is a reflective and instructive commentary on their (the engineers') universal lack of enterprise to leave it to me, and those associated with me, to be the pioneers of the tube's re-equipment and re-utilisation electrically. Surely, with such a common knowledge, some one of the multitudinous engineers with electrical qualifications might ere this have turned his information to account, and have forestalled my connection with the project.

The truth, however, again is affirmed of every man's knowledge being no man's knowledge, and hence the fuss now arising. On that score I am content to let your remarks pass.

What I do most strenuously protest against, however, is the quotation of a contemporary's recent "Leaderette" as a caution to investors. This, I contend, was unnecessarily gratuitous, especially as in a recent issue you inserted an article upon the very subject, and must, therefore, have thought something of the scheme.

But your contemporary has been a "little too previous" with his philanthropic advice. Investors are not invited nor sought in the matter at all. We have all the money we want, privately subscribed. Not one word has ever been spoken or implied that the case was otherwise. Consequently, though I passed by the stupid admonition of your contemporary for the value it was worth, I am not disposed to permit its quotation by representative journals, as though warranted by any statement, hint or suggestion that could or would be construed as a financial appeal. Let me make the situation absolutely clear and unequivocal. We want no money beyond that which we possess; and I trust you will give this fact the same prominence as afforded your contemporary's magnanimous care for the "wild cat" speculator.

G. Threlfall.

Single-Phase Motors.

I have to thank Mr. C. E. L. Brown for his letter in your issue of the 13th inst. on the subject of my recent article on the Heyland single-phase motors. I have drawn Mr. Heyland's attention to it, and he will probably give us his views in due course.

Doubtless, in common with most other people, I supposed every detail of these motors to be new, as it is, of course, only possible to form an opinion on such matters based upon machines actually constructed and put on the market. But, after all, the main point is that we can build these Heyland motors in any size, and under guarantee, to start against full load, even for 100 cycle circuits, and can also guarantee the current consumptions. This is a result that has been attained by no one else *anywhere*.

Under these circumstances it would appear to be a waste of time to start a discussion on one feature of an entirely new design.

A. C. Eborall.

October 17*th*, 1899.

The Hastings Accident.

It certainly would appear that Mr. Andrews will have to return to his opinion that the sudden failure of his alternators was due to a break in the exciter shunt; at all events, in the absence of a better explanation, this should not be discarded.

It is not very clearly proved that the extinction was absolutely instantaneous.

For our part, we had an opportunity here of seeing the exciter shunt accidentally broken, and the effect on the lights *was sudden enough for anything;* in fact, it was universally agreed that they went out as if switched off.

I have not the least doubt now that had we repeated the operation as an experiment in cold blood we should have seen that it is as Mr. Andrews says—the lights went out more or less gradually.

As regards the trouble with the circuits, and the machines flashing to earth, I feel sure nearly all this would disappear if a one-to-one transformer were interposed in the public lighting circuit, for I take it that the Hastings arc circuits, like many elsewhere, test the worst, and consequently put a strain on the other circuits, although I do not quite follow the reasoning as to a difference of potential higher than 2,000 volts; this, however, is sufficient.

Geo. Marshall Harriss,
Urban District Electrical Engineer.

Bray, *October* 17*th*, 1899.

BUSINESS NOTICES, &c.

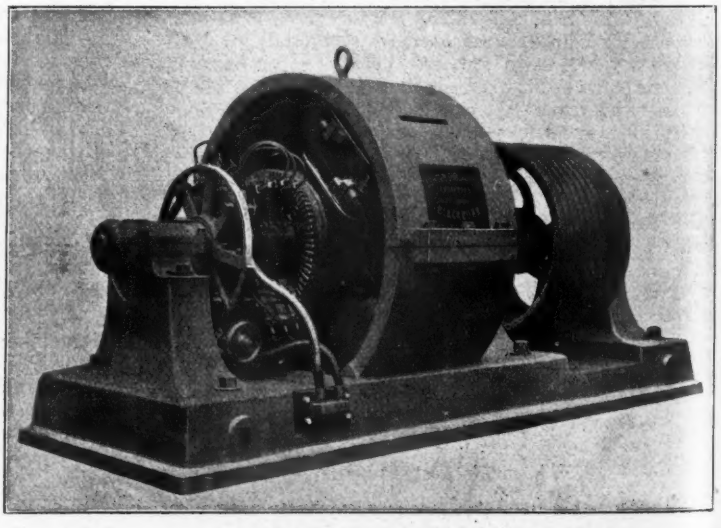
Electrical Wares Exported.

Week ending Oct. 18th, 1898.		Week ending Oct. 17th, 1899.	
Adelaide	Value £5,189	Alexandria	Value £29
Aden	900	Amsterdam	37
Alexandria	72	Bombay	104
Algoa Bay	149	Brussels	18
Amsterdam	87	„ Teleg. mat. ..	300
Antwerp. Elec. fuse	551	Buenos Ayres	351
Bombay	139	Calcutta	84
Boulogne	57	Cape Town	307
Brisbane	77	„ Teleg. cable..	334,000
Buenos Ayres	288	„ Teleg. wire	467
Bushire	8	Christchurch	27
Calcutta	18	Christiania. Teleg. wire ..	29
Cape Town	670	Colombo	19
Chinde	1,118	Copenhagen. Teleg. wire ..	10
Copenhagen	45	Durban. Electric light cable and appliances	1,041
Delagoa Bay	235	Fremantle. Teleg. mat. ..	62
Durban	182	Halifax. Teleg. mat.	6,503
Fremantle	99	Hamburg. Teleg. mat.	250
Ghent	83	Malta..	20
Hamburg	400	Melbourne	462
Hong Kong	15	Montreal	15
Kobe	111	Otago	85
Liban	87	Perth	84
Malta	75	Port Elizabeth	110
Melbourne	220	Rotterdam	69
Montreal	40	Shanghai	7
Naples	26	Singapore	100
Port Elizabeth	188	„ Teleg. mat.	179
Rio Janeiro..	310	Stockholm. Teleg. mat. ..	76
„ „ Teleg. mat. ..	44	Sydney	962
St. Petersburg. Teleph. mat...	40	Townsville. Teleg. wire ..	375
Shanghai. Teleg. cable ..	1,157	Vladivostock	31
Stockholm. Teleg. cable ..	716	Wellington	154
Spezzia	121	„ Teleph. mat. ..	160
Sydney	678	Yokohama	206
„ Teleg. mat.	590	„ Elec. cable ..	2,583
Trieste. Teleg. mat.	20		
Wellington	132		
Yokohama	56		
„ Elec. cable	973		
Total ..	£15,914	Total ..	£349,366

Foreign Goods Transhipped.

Calcutta	Value £48	Havre. Elec. mach. ..	Value £120
Halifax	16		
Sydney	50		
Total	£114	Total	£120

New Dynamo.—We illustrate a four-pole 80-KW. dynamo made by Messrs. Ashton, Frost & Co., Limited, of Blackburn. This machine was designed to give 110 volts 720 amperes at 500 revolutions per minute. On its trial test it was run for 7 hours at 110 volts 850 amperes, and the speed was found to be 475 revolutions per minute; the rise in temperature above the surrounding atmosphere was found to be:—Fields, 45° F.; armature, 59° F.; commutator, 10° F.; and the commercial efficiency to be 94 per cent. The angular lead required between no load and 20 per cent. overload was 6°, and at any time 200 amperes could be thrown on or off without sparking and without alteration of lead. The machine has been built for Messrs. Richard Thompson and Sons, Alma and Britannia Mills, Padiham, and we are informed that the above tests were carried out by their consulting engineer, Mr. A. Kelly, of Liverpool. The armature is of the makers' slotted drum type, with a helical lap winding. The holes cast in the bedplate shown in the illustration are for the tightening bolts, the slide rails and screw gear being of Ashton, Frost & Co., Limited, special type, requiring only one lever to be operated for the forward movement of the whole machine. The magnets and yoke are built of cast-steel and arranged with an inch slot through each magnet carried through the yoke parallel to the shaft, a device the makers have found of considerable service in large machines.



New Dynamo.

Bankruptcy Proceedings.—At Liverpool on 12th inst., before Mr. Registrar Cooper, Benjamin Wild and John Henry Clarke, trading as Wild, Rothwell & Co., general and electrical engineers, Atlas Works, Southport, came up for adjourned public examination. Mr. Jones (Brighouse & Jones) appeared for the trustee, and examined Mr. Wild upon various matters, amongst them as to the number of executions that had been put in the firm's premises. He admitted that they were over 50, but he did not think they were 100 in number. Several had been in at one time in May last. He did not remember having, the night before the receiving order was made, said to a Mr. Gregson that he was a £1,000 to the good. He denied having asked Mr. Gregson for a loan of £1,000. He had, however, asked for £40 or £50.—The examination was closed.

The first meeting of creditors in C. F. S. Pilling, electrician, is to be held at 16, Wood Street, Bolton, on October 20th, and the public examination at the Court House, Mawdsley Street, Bolton, on November 7th.

The first meeting and public examination of William Upton, electrician, Bridge Street, Banbury, are arranged for October 20th and 25th respectively, the former at the Official Receiver's office, 1, St. Aldates Street, Oxford, and the latter at the Town Hall, Banbury.

Liquidation Notices.— Creditors of the Superheated Steam Power Company must send their names and the usual particulars to the liquidator (Mr. T. L. Hurry, 8, Queen Anne's Gate, S.W.), by November 13th. A meeting will be held at that address on November 16th to hear an account of the winding up proceedings.

Creditors of the Prism Globe Syndicate must send particulars of debts, &c., to the liquidator, Mr. J. H. Bardsley, 60, King Street, Manchester, by December 1st.

Books Received.—"La Télégraphie Sans Fils," by André Broca. Paris: Gauthier-Villars, 1899. 3 francs 50 cents.

"The British Electric Traction Company in South Staffordshire"; an interesting pamphlet giving maps and notes of the company's schemes. We hope to refer to this at length next week.

Catalogues, &c.—Messrs. Brioschi, Finzi & Co., of Milan, are circulating a list, with letterpress in Italian, in which they illustrate and give a few notes of three-phase generators, high-tension alternators, and motors for electric tramway and other work.

From Mr. G. Braulik, of Upper Thames Street, we have received his latest incandescent lamp list, in which is shown a great variety of lamps of all shapes and sizes and for different voltages. The London standard "Philips" lamps and other types, from 8 to 100 C.P., special patent lampholders for high C.P. lamps, conical lamps (half opal), the patent round, flame, tubular, tramway, and other lamps are among those illustrated and priced in the list.

The Langdon-Davies Electric Motor Company, Limited, send us a revised price list for insertion in their catalogue. It has been considered desirable that motors should be run at lower speeds than their standard pattern motors where small size and highest efficiency are not of so much importance, and the list before us gives prices, &c., of special low speed pattern motors.

Yorkshire College Engineering Society.—The syllabus for the 1899-1900 session is printed, and includes the following items:—

Monday, October 23rd, 1899.—President's address and inaugural paper: "Workshop Training with Technical Education," by Wilson Hartnell, M.I.Mech.E.

Monday, December 18th.—"The Generation, Transformation, and Distribution of Multiphase Alternating Currents for Tram and Railway Work," by G. D. Aspinall Parr, A.M.I.E.E.

Monday, January 29th, 1900.—"Evaporative Condensers," by W. H. Roy (Klein Engineering Company).

Monday, February 12th.—Results of experiments made in the engineering laboratories of the Yorkshire College, by the Students.

Electricity for Newspaper Presses.—The Bullock Electric Manufacturing Company, of Cincinnati, are issuing a new list (September, 1899) of their electric power system for operating newspaper presses. Among the pictures are a type E Bullock motor direct connected to Hoe sextuple press with colour attachment, a motor direct connected to a Cottrell perfecting magazine press at a Berlin factory, and a view of the press room of the Munsey Magazine Company (equipped with Bullock motors). The Bullock method of supplying current to the motor is said to result in efficient control and economy of current consumed, there being no waste of power in regulating the speed of the motor, or heavy draughts upon the source of supply when starting. By means of curves this is shown in the list before us. With the Bullock "Teaser method" the starting current is shown to be but 30 per cent. of the current at full load, an economy which would be impossible with rheostatic control. Steadiness of operation is claimed as an advantage of the Teaser method, as against a tendency toward uneven, jerky movement with rheostatic control, which it requires constant manipulation of the rheostat to overcome. The

Bullock press controller and switchboard, and E type motor, are illustrated. It appears that the Bullock "Teaser" method is employed in the production of English papers as follows:—The *Manchester Sporting Chronicle*, five Hoe newspaper presses; the *Belfast Evening News*, one "Victory" printing press; London *Daily Mail*, two Hoe newspaper presses; *Nottingham Guardian*, one Hoe newspaper press; *Birmingham Daily Post*, one Hoe newspaper press; *Aberdeen Free Press*, one Hoe newspaper press; *The Scotsman*, four Hoe newspaper presses.

The new premises now in course of erection for the *Scotsman* will contain "Hoe" quadruple and four-reel fast rotary presses together having a capacity of turning out, printed, cut, and folded, 96,000 copies of a 16-page *Scotsman* per hour, or 192,000 copies of an eight-page paper per hour. The 50-H.P. electric motors which will drive these presses have been constructed at Cincinnati, U.S.A., specially for the work.

Messrs. W. & G. Baird, Limited, of Royal Avenue, Belfast, have just added in their new litho-room the latest type of Furnival machine, driven by electric power. The motor was supplied by the Bullock Company.

The Copper Situation.—The *Times* London Market Report of 16th inst. has the following *re* the copper market:—

Prices opened 6s. 3d. lower and receded further, which induced good buying and a recovery of 5s., the movement being helped by a decrease in the Liverpool and Swansea stocks of 2,589 tons, due to further shipments of Chili bars to America, while a leading house took 250 tons in a line at the best price of the morning. American shipments for last week only totalled 1,853 tons, and there were expectations of a favourable statistical return. Sales 900 tons, cash and near dates going at £75 10s., 8s. 9d., 11s. 3d., 10s., and 12s. 6d., and three months at £76, £75 15s., and £76. In the afternoon, on the visible supply showing a substantial decrease, values hardened fully 2s. 6d., with transactions passing at £75 13s. 9d. and 15s. for cash, and £76 2s. 6d. for three months. The depreciation on the day is 8s. 9d. per ton. Total turnover 1,300 tons. Settlement price, £75 12s. 6d. Messrs. H. R. Merton & Co., Limited, give the total receipts for the first half of the current month as 8,070 tons, and the deliveries 10,834, making stocks in England and France on the 15th inst. 20,614 tons, against 28,978 tons on September 30th, and 24,877 a month ago. The visible supply now totals 26,164 tons, and compares with 28,328 on September 30th, and 31,527 a month ago. The shipments for the fortnight from Chili were 750 tons.

The last issue of the New York *Electrical World and Engineer* to hand says:—

Copper, as we anticipated, is already a shade lower, and was quoted last week at 18¾ cents for Lake, although even at that price customers apparently did not want any of it for the present. There are so many reports as to possibly cheaper copper, due to new production, people begin to believe them. But as the price falls, the demand will rise, so that a sharp decline can hardly be expected.

Durham College Old Students.—We have received the second annual report of the committee of the Durham College of Science Old Students' Union for the 1898-99 session, together with a list of students.

An Electrical Engineer's Defalcations.—On 12th inst. Herbert H. Hall was charged at the Liverpool City Police Court with having, on September 22nd, stolen the sum of £12 6s. 10d., the property of the Walsall Electrical Engineering Company; also with having, on three days in September, obtained by false pretences the sum of £72 6s. 3d. Prisoner was electrical engineer at the Liverpool branch of the Walsall Company. It appeared from the evidence given that his defalcations, covering several months, amounted to over £500. He was sentenced to six weeks' hard labour on each of four charges, six months in all.

Factory Driving.—Messrs. D. Bruce Peebles & Co. have received the contract for the complete equipment of plant for electric driving and lighting at Messrs. Ogdens' tobacco factory. There will be 360 H.P. in generators, 300 H.P. in motors, switchboard and booster. Messrs. Sloan & Lloyd-Barnes, 34, Castle Street, Liverpool, are the consulting engineers.

Fire. — We are informed that the statements which appeared in the daily press that a large fire occurred at the works of W. T. Henley's Telegraph Works Company, Limited, on 13th inst are misleading. The fire was of so trivial a nature as to cause no inconvenience or interruption to any portion of the business. The services of the public fire engines were not required.

For Sale.—The School Board for London is offering for sale two 32-KW. dynamos, direct coupled to two Parsons' steam dynamos, also switchboard, cable, &c. See "Official Notices" this week.

Infringement. — The Wireless Telegraph and Signal Company notifies in our advertisment pages that proceedings will be taken against those who sell, buy, or use certain instruments which are infringements of the Marconi patents.

National Telephone Company, Limited, v. Bowra.—In the Chancery Division of the High Court of Justice on Wednesday, October 11th, Mr. Justice Darling, sitting as Vacation Judge, had again before him the matter of the National Telephone Company, Limited, *v.* Bowra, which was an application by the plaintiff company for an injunction against the defendant to restrain him from interfering with a telephone pole, stay wires, and appliances connected therewith, on certain premises at Streatham Hill. Defendant appeared in person. Mr. Cassell, who represented the company, said that an interim injunction had been granted on September 22nd, and last week the motion stood over, the injunction being meanwhile continued. Since then the solicitors representing the landlord of the premises had filed an affidavit to the effect that defendant had no longer any interest in the place through non-payment of rent. Defendant denied that such was the case, and claimed that the lease was still in force. His Lordship, after hearing defendant at considerable length, ordered the injunction to be continued pending the hearing of the action.

New Journal.—The interests of the automobile industry are being well looked after in this country, judging from the number of journals which have been brought out during the past few years, since the passing of the 1896 Act. The latest addition to the family is the *Motor Car World*, a 3d. monthly review, of which the first number is now before us. It is crowded with news from all parts, but also has articles on motor car management, steering gear, and reviewing the world's press. An important article, and seemingly a very necessary one, gives advice of what to do when the motor won't work. Messrs. Hay, Nisbet & Co., Limited, of 25, Bouverie Street, E.C., are the publishers.

Rashleigh Phipps v. Ford.—In the Westminster County Court on Friday last his Honour Judge Lumley Smith, Q.C., had before him the case of Rashleigh Phipps & Co. *v.* Ford. This was an action brought to recover the balance of an account of £170 for work done at the house of the defendant in Bolton Street, Piccadilly. The only question was as to an item of £7 for the repair of the ceiling of the dining room. The defendant urged that in the course of the work of fitting the house with electricity, the plaintiffs damaged the ceiling to the amount of £7, and gave him instructions to have the work done. Plaintiffs denied they or their men caused the damage, and they gave no authority for the work to be done. They were, however, willing to pay one half, and had offered to do so.—His Honour, after a hearing, found that no damage was done by the plaintiffs. As they were willing to allow the moiety, and that having been paid into Court, he found against the defendant with costs.

Staff Dinner.—The annual staff dinner of the Electrical Power Storage Company was held on Monday last, at the Holborn Restaurant, when a company of 48 sat down to dinner under the presidency of Mr. J. Irving Courtenay, the chairman of the company, who was supported by Mr. Frederick Green, a director of the company. After dinner, the usual toasts were drunk, interspersed with instrumental and vocal music, several items of the programme being contributed by the members of the staff themselves, and altogether a very pleasant evening was spent. A letter was received from Sir Daniel Cooper, Bart., regretting his inability to be present.

Trade Announcements.—We learn that Mr. Archibald Campbell, of 28, Gray's Inn Road, W.C., has been appointed agent for the old established cable makers of Messrs. G. B. Unsworth and Sons, Limited, of Derby. He holds stocks of cables, flexibles, silk covered wires, and insulating material.

We last week recorded the registration of the Prism Globe Company, Limited, and also the liquidation of the old syndicate. The new company has a much larger capital than the syndicate had, and the reason for the increase is found in the growing business which is anticipated, now that the company has the patent rights for Europe and the Colonies, South Africa, and South America—indeed, for all parts of the world excepting the United States. The cheerful outlook, therefore, has rendered necessary or desirable the putting down of triplicate machinery for manufacturing the company's specialities both here and abroad.

A Zinc Combine.—*Money* has the following comments regarding the rumoured spelter combine:—"The syndicate which touched copper and turned it into gold has been credited for some time past with a desire to form a zinc trust. The difficulties in the way, however, if not insuperable, have been so many, that the whole thing is still in the air. Now comes news that the Continental and American producers, who so far have altogether failed to agree on terms, are getting nearer a settlement, and that we may see zinc controlled by a syndicate after all. So far America is not a very large producer of zinc, and exports have latterly been on a smaller scale. It is known, however, that the industry there has been in the throes of consolidation, but, as the *Financial Times* has pointed out, the Continental producers feel that it would be dangerous to form a Trust which did not include Yankee interests. Of a total output of 460,000 tons, German, Belgian, and American producers could control about 350,000, which would give it a fine grip of the market. With small stocks and low prices to give it a send off, a Trust of these dimensions could easily manipulate the market. It will, however, take a lot of negotiation to arrange the deal."

ELECTRIC LIGHTING NOTES.

Bangor.—The municipal electricity works are expected to be completed about the end of the year.

Basingstoke.—The Town Council has decided to proceed with its application for a provisional order.

Bath.—Colonel A. G. Durnford, Local Government Board inspector, held an inquiry into the application of the Urban Sanitary Authority for power to borrow £26,000 for electric light purposes. Mr. R. Hammond, electrical engineer, explained how the items were composed:—For additional plant, for the laying down of a low tension network, for extension of public and private lighting mains, coal trucks, &c. Mr. Metzger, city electrical engineer, estimated that £82 a year would be saved by purchasing their own coal trucks, and the arrangement with the Great Western Railway for tipping direct into the arches below the line. There was no opposition.

Belfast.—The report of the electrical engineer, Mr. McCowen, to the Electricity Committee shows that the department is making good progress, and the revenue last quarter was 61½ per cent. greater than for the corresponding period last year.

Bootle.—The price of electricity is to be reduced from 7d. to 5d. per unit for the first hour and 3d. afterwards. The Council will take over the station to-day, 20th inst., on certain conditions.

Bradford.—The City Council has resolved to extend the electricity works at a cost of £10,000. Figures were given at a recent meeting showing the working of the electricity department for the half-year ended June 30th. The total income had been £13,256, as compared with £9,565 for the corresponding period, or an increase of £3,690. The total expenditure had been £11,523, as against £7,907, a difference of £3,616. The profit was £1,733, as against £1,658, an increase of £74 on the last corresponding period. The number of consumers was 965, an increase of 34 per cent. The total profit since the opening of the works was £22,616, the total amount written off being £10,556 for depreciation, leaving £12,059 to be appropriated. The trade profit had been £4 3s. 11d. per cent. on a capital outlay of £180,129, with a net profit of 19s. 3d. per cent.

Carlisle.—The Electric Lighting Committee of the Town Council has accepted tenders for extending the electric lighting plant, at a cost of about £2,000.

Chadderton.—The District Council has decided to instruct the General Purposes Committee to take into consideration the advisability of obtaining an order for electric lighting.

Cheadle.—The District Council has decided to apply to the Board of Trade for a provisional order authorising the Council to supply electricity in the district. It has also resolved to appoint Messrs. Medhurst & Page, of Manchester, engineers to the Council in obtaining the provisional order.

Cleethorpes.—The Electric Lighting Committee recommended the District Council that the township be lit with the electric light, and that Mr. V. Brown, of Lincoln, be appointed electrical expert to the Council, to inspect the district and report. The Committee's recommendations were adopted.

Cork.—The Committee of Management of the Cork District Lunatic Asylum has resolved to light the new buildings with electricity, to be generated by means of a gas engine.

Cresswell.—The Parish Council has decided to adopt the Lighting and Watching Act of 1883, with a view to the electric lighting of the village.

Ealing.—The District Council has resolved to increase the salary of the electrical engineer (Mr. Knight) to £400 per annum, with an annual advance of £50 to £500.

East Ham.—In regard to our "Traction Note" under this heading last week, it seems that what the *Essex Times* describes as a "new and important decision" was given out by Major-General H. D. Crozier, R.E., at the Local Government Board inquiry held last week in reference to an application of the Council for sanction to borrow £41,499 for electric lighting. We print the following account of the discussion which arose between the inspector and the Council's officials, as it may possess a certain interest for municipal engineers in different parts of the country:—

The Surveyor: The doings of the Council are thoroughly well known, and there has been no opposition.

The Clerk: Our proceedings are thoroughly well known, and we have authority from the Board of Trade for these works.

The Inspector: They don't sanction loans.

The Clerk: It is an anomaly having to go to one board for power to establish electric trams, and to another for sanction for a loan.

The Inspector: No, it is not an anomaly at all, because the Board of Trade are looking after the use of electricity and the safety of the public; but the local loans are entirely in the hands of the Local Government Board, and they are responsible to Parliament.

The sanction of the Board of Trade was produced by the clerk.

The Inspector: This is curious. I was not aware of this. There is no particular object in sending this up. I see they have sanctioned two sums. It is the first time I have come across this. It is quite a new thing. It will lead to trouble in the future. Are you going to do this work yourselves?

Mr. Ullman (the electrical engineer): Yes.

The Inspector: How are you going to get the men?

The Surveyor: So far the Council have decided to do without contractors as far as possible. It is not definitely settled. Eventually they may go to the contractors. Up to the present they have decided to do the work without them.

The Inspector: Where are the workmen coming from? Are you going to do it?

The Surveyor: No.

The Inspector: I mean are your men going to do it?

The Surveyor: No. I am relinquishing my post at Christmas.

The Inspector: That is talking personally as surveyor. The Council have decided to do as much as possible without the aid of the contractor, laying of cables, &c. In what way, Mr. Ullman, are you going to do it? Are you going to set up a staff? You cannot do it yourself.

Mr. Ullman: If the Council decide that I shall do it, I shall have to get a staff together.

The Inspector: Are you giving to him a separate staff? Can I say that you will do it by men entirely independent of the Council? That you will not draw upon the Council's workmen? You understand my point, Mr. Clerk?

The Clerk: Yes, I understand your point well enough, but I cannot answer it.

The Inspector: Understand my point. You are going to borrow the money, and you cannot employ any man on your permanent staff under the Public Health Act to do this work on borrowed money.

The Surveyor: I have done it for years. Do you mean to say that that is illegal?

The Inspector: You are not to employ men in the permanent employ of the Council to do this extra work on borrowed money. That is the law. I want to know exactly how you are going to do it, because if the electrical engineer says he will have a separate staff for the work that puts an end to the matter.

The Surveyor: There is nothing to prevent me from putting men in my employ to the work if I think fit. The matter is going to be considered further, and the Council may alter their present intentions.

The Inspector: When work is done out of borrowed money it is not to be carried out by persons in your regular employ. That does not agree with your opinion, but it is the law.

Handsworth.—The District Council has appointed a sub-committee to deal with the question of electric lighting.

Edinburgh.—At a meeting of the Electric Lighting Committee of the Town Council last week a report was submitted by the engineers on the progress of the Dewar Place and M'Donald Road stations. The report states that this time two years ago the number of lamps (equivalent to 8 C.P.) connected in the city was 109,000, and the evening load (continuous current) was 6,080 amperes at 230 volts. By Christmas, 1897, these numbers had increased to 127,000 lamps and 8,770 amperes. Twelve months ago there had been a further increase to 177,000 lamps and 8,403 amperes, and for about three weeks near the end of October last year there was great difficulty in getting up the electric pressure—a difficulty only overcome in November by the erection for temporary use of two large fans and an iron chimney in connection with the boiler flues. With these and with the plant on order, a portion of which was delivered just in time, the station delivered last Christmas as its maximum load (on the continuous side) 11,300 amperes, the number of lamps then connected being 184,000. Of the four large new Sterling boilers one is now at work, the second is nearly ready, and the third is far advanced. There is now, happily, no doubt that all these will be in working order for the winter's load. The temporary fans and chimney have been used during the summer as required. Without them it would have been impossible to set free the main chimney for the purpose of making the connection of the two large permanent fans which are being erected by Heenan & Froude. The present maximum load on the station (continuous current) is 10,700 amperes, or very nearly as much as the Christmas load of last year. There are now connected 245,000 lamps, and the maximum load corresponds to nearly 40 per cent. of these being alight at one time. The increase of lamps since the beginning of the year has been enormous, being at the average rate of over 1,500 per week for the past nine months. By the end of the year the lamps connected will be about 265,000, and the maximum total load will probably reach 17,000 amperes. The supply will in future be delivered from Dewar Place to the west and central parts of the city, as well as such outlying districts as are supplied by alternating current, the bulk of the city, as the demand grows, being supplied from the M'Donald Road station. Strenuous efforts have been made to get the M'Donald Road station ready in time for the winter's load. Seven boilers have been delivered and tested. Two smaller engines, with their dynamos, have been completed, and the first large (1,200 H.P.) steam engine and dynamo, which were fully tested in the makers' works before delivery, were started successfully in the station. Each of the large M'Donald Road machines can supply 3,200 amperes, and each is, therefore, of sufficient power to keep about 24,000 lamps alight at once. The smaller machines are about a fifth of the size of the large ones. With the work in this condition, there is no doubt the two stations will be able to work together for the winter as intended, and there will be ample power for the winter's demands, although the actual number of lamps has increased far faster than even the most sanguine could have anticipated. The report is signed by Prof. Kennedy and Mr. Newington.

Gainsborough.—The District Council has consented to receive a deputation from the Northern Counties Electric Supply Company in connection with a proposed scheme of electric lighting.

Glasgow.—The Machinery and Electric Lighting Committee of the 1901 Exhibition have so far decided to accept combined engines and dynamos from the following firms:—Messrs. Alley & MacLellan, Glasgow; Scott & Mountain, Limited, Newcastle; Mavor & Coulson, Limited, Glasgow; Edison & Swan Co., Limited, Glasgow; Bruce Peebles & Co., Edinburgh; Wm. Sissons and Co., Gloucester; Robey & Co., Limited, Lincoln; Ruston, Proctor & Co., Lincoln. Negotiations are proceeding with others.

Harwich.—The Council has received a cheque for £300 from the English Industrials, Limited, for the transfer of the provisional order to a new company, to be known as the Harwich Electric Lighting and Tramways Company. The Council was recommended by committee to grant leave to the company to lay their electric tramlines along a number of specified thoroughfares. The lines will run to Dovercourt. This part of the scheme was referred to committee for further information as to system, &c.

Hexham.—The District Council has decided to oppose the proposed application of the Northern Counties Electricity Supply Company for a provisional order for lighting the district.

Holborn.—The Holborn Board of Works has received complaints from tradespeople and others in the district that the electric lighting companies are doing injury to their businesses by opening the roads for laying mains, and asking that the companies be compelled, if possible, to continue operations during the night as well as by day, so as to complete them as rapidly as possible. It is thought, however, that the Board has no power of interference. The Works' Committee is inquiring as to the company's power under its Act.

Jarrow.—The proposal to provide the district with electric lighting and power has been remitted to a special Committee of the Town Council. Offers have been received from various companies. It was agreed to call in an expert to advise the Council.

Leigh.—The District Council will commence to supply electricity to consumers in November or December, and will probably decide upon an extension of the original scheme.

Leith.—The Electric Lighting Committee has resolved to reduce the price of electrical energy by 1d. per unit from January 1st next, and in view of the increased demand, to obtain estimates for a new combined engine and dynamo.

Lewes.—The *London Gazette* of the 17th inst. contains notice of the transfer of the Corporation's electric lighting order (1898) to the County of Sussex Electrical Power Distribution Company.

Loftus.—Representatives of the Northern Counties Electrical Supply Company, Newcastle, waited upon the District Council last Friday with respect to a proposal which that company has placed before the Council, to instal a system of electric lighting in the district. It was agreed that the Council should discuss the question at a special meeting.

Ludlow.—The Electric Lighting Committee of the Town Council has the question of proceeding with an electric lighting scheme for the borough under consideration.

Maidstone.—The District Council has decided to raise a loan of £30,000 to carry out a scheme of electric lighting combined with a dust destructor.

Mr. H. Boot, the electrical engineer at Tunbridge Wells, addressed a meeting here under the auspices of the Maidstone Ratepayers' Association, on 16th inst., on the advantages of municipal electric lighting.

Manchester.—A Local Government Board inquiry was held at Manchester on Tuesday last with reference to an application by the Corporation for power to borrow an additional sum of £22,000 for the purchase of land required for extensions. The following particulars were given showing the commercial success of the electricity undertaking of Manchester, which has been a success almost from the beginning. Work was commenced in August, 1893, and at the end of the first eight months there was a deficit of £209. At that time the charge was 8d. per unit, the maximum amount allowed to be charged under the order of the Board of Trade. At the end of the following year (1895), with the increased number of lamps and plant at the disposal of the Committee, the surplus net profit was £5,709, after paying interest on moneys, transferring an amount to sinking fund, and in addition a sum of £4,000 to renewals account. At the end of 1896, the price having been reduced from 8d. to 6d per unit, there was a net profit of £11,128. An amount was transferred to the renewals account of £3,491, and there was paid to the city fund in aid of rates £6,963. At the end of the following year—1897—the net profits amounted to £16,812, the price remaining the same. A sum of £2,307 was transferred to renewals account, and £10,000 was paid to the city fund. In 1898 the prices were reduced from 6d. to 5d. per unit for short-hour consumers, with reductions to long-hour consumers. The net profits in that year were £13,522, and £10,000 was paid to the city fund. In the year 1899, the prices remaining the same, the Committee made a net profit of £17,188. A sum of £3,344 was transferred to renewals account, and £12,000 was handed over to the city fund in aid of the rates. The financial year ended in March. In March this year there was a balance to renewals and suspense account of £12,794, and to the credit of the reserve fund £23,197, making a total to the credit of the Committee of £35,992. The prices charged by the Committee bore very favourable comparison with prices charged in other cities; indeed, taking the average price upon the whole of the charges, they are the lowest in the kingdom. Mr. C. H. Wordingham, electrical engineer to the Corporation, added that the electrical undertakings of the Corporation had attained very large dimensions, and great developments were about to take place. The present area supplied by the Corporation was, approximately, 16 square miles. They were under obligations very shortly to increase that area to 45 square miles, roughly, and there was a likelihood that that would be considerably augmented. That included not merely the city, but outside districts such as Moss Side, Levenshulme, and Withington. Upwards of 500 men were at the present time employed by the Committee in the laying of mains and the maintenance of those already laid, and that number would have to be added to very shortly.

On Wednesday morning an electric main box explosion occurred in Market Street, lifting the flagstones, &c., in the usual way.

Mexborough.—Colonel A. J. Hepper, R.E., Inspector of the Local Government Board, held an inquiry last week in regard to an application by the District Council for powers to borrow £1,428 for the purchase of land for plant for electric lighting and for other purposes.

Mossley.—The Town Council has appointed a sub-committee to inquire into and report upon the advisability of obtaining Parliamentary powers to supply electricity in the borough, both for lighting and motive power, and either alone or jointly with any neighbouring authority.

Neath.—A private meeting of the Town Council was held on Thursday last week to consider proposals respecting an electric light installation, made by Messrs. Lewis & Fletcher, of Cardiff. After the discussion, during which it was pointed out that the gas undertaking, of which the Corporation are the owners, was yielding excellent results, it was decided to reject the proposals. We trust that the promoters will not be discouraged by such a lame excuse.

Newington.—The Vestry has resolved to instal two additional boilers and a 400-kw. steam dynamo in the electricity works, and to apply to the County Council for a loan of £15,500, repayable in 42 years. Cables are also to be laid in certain side streets.

Perth.—The Police Commissioners last week had under consideration the recommendation of the Electric Lighting Committee to accept offers for the new electricity supply works, recommended by the engineer, Mr. Hawtayne. It was agreed to accept the offers recommended, and Mr. Hawtayne was instructed to issue specifications and take in offers. The meeting also agreed to make payment to Mr. Hawtayne of £500 on account for his services. The offers accepted amount to £22,336 13s. The original estimate for these works by Mr. Hawtayne was £23,350.

Pendleton.—The Salford Corporation proposes to provide an electricity generating station in Strawberry Road, Pendleton. Sanction has already been obtained to the loan of money for the purchase of the site, and the Corporation has applied for permission to borrow £10,000 for the provision of the necessary buildings and meters. An inquiry into the application was made by Mr. G. W. Williams, an inspector of the Local Government Board, at the Town Hall, Bexley Square. It was stated that the present application was especially urgent, as electric power would soon be required for the tramways. The Corporation would shortly ask permission to borrow £72,000 for the electric lighting scheme. The buildings in respect of which the present application was made would be used as a low tension generating station and battery substation.

Fort William.—The Electric Light Company has given notice that on and after November 1st next the charge for current will be at the uniform rate of 6½d. per Board of Trade unit, instead of the differential rates of 9d. and 4½d. at present charged. It is also stipulated that the minimum charge for light per quarter will, in all cases, be 5s.

Portmadoc.—At a special meeting of the Town Council last week, a long discussion took place with reference to the advisability of lighting the town by electricity. The matter was adjourned to the ordinary meeting of the council.

Portslade-by-Sea.—The District Council has set on foot inquiries *re* electric lighting, with a view to applying for a provisional order.

Prestwich.—The District Council has resolved that application be made to the Board of Trade for a provisional order authorising the Council to supply electricity for public and private purposes within the whole of the district, and also for power to construct tramways along Middleton Road, Bury Old Road, and Bury New Road.

Rochester.—At the Corporation meeting on Wednesday last week, the Estates Committee read a letter from the Chatham, &c., Electric Lighting Company, asking the committee to receive a deputation to express their views upon the subject of the application of the Electric Power Distributing Company's application for a provisional order to supply electric current for light, heat, &c., within the city. It was resolved that the town clerk reply that the committee will be pleased to receive a deputation so soon as it is known that the Electric Power Distributing Company intend to proceed with their application.

Ruislip.—The Parish Council is negotiating with the Uxbridge and District Development Syndicate, Limited, with a view to the inclusion of the parish in the area for which electricity supply powers are about to be obtained by the company.

Sale.—At the last meeting of the District Council it was reported that in case the Manchester Corporation came to an arrangement to supply Stretford, they would be willing to supply Sale in bulk at 3d. per unit. The Altrincham Electric Supply, Limited, are willing to connect their cable with School Road, but the price to be charged would be 6d. per unit. It was decided to apply to the Board of Trade for an extension of the time for carrying out the order, explaining the circumstances.

Singapore.—*Indian Engineering* says that the Colonial engineer has reported in favour of lighting Singapore with electricity, on the ground that it is cheaper than gas.

Sittingbourne.—The District Council of Sittingbourne, Kent, is taking steps towards obtaining the necessary powers under the Electric Lighting Acts for the introduction of electric lighting into the town.

Slough.—The District Council last week discussed a motion that application be made to the Board of Trade in the forthcoming session for a provisional order authorising the supply of electricity in the urban district. It having been stated that the Board of Trade has decided to omit from any provisional order granted to a local authority under the Electric Lighting Acts, 1882 to 1890, the power of the local authority to transfer their undertaking, save in exceptional cases, where very special reasons can be shown, it was decided to wait until the waterworks and other schemes are completed before obtaining the order.

Southampton.—The Town Council has resolved to apply to the Local Government Board for leave to borrow £55,000 for electric lighting purposes.

Southport.—Last week the Mayor of Southport, Councillor C. E. Austin, started the new steam alternator at the electricity works, in the presence of a large number of guests. It was stated that the total capacity of the engines at the works is now 2,000 I.H.P., and at the present time connections are being made at the rate of 10,000 8-c.p. lamps per annum. There are 600 consumers, with upwards of 40,000 lamps of 8-c.p. The capital expenditure amounted in March last to £90,000, and more has been incurred since then. The income for last year exceeded £9,350. The profits have advanced to over £2,000 in the last 12 months, after all liabilities had been met. At the same time the price has been reduced from 6·96d., in 1896, to 4·07d. last year, or a diminution of nearly 3d. per unit in three years.

Stamford.—The Town Council has decided to engage an electrical expert, at a cost not exceeding £25, to assist the Sub-committee of the Electric Lighting Committee to prepare a report on the question of electricity supply. Letters have been received from Messrs. Edmundson's Electricity Corporation, Limited, pointing out that the Board of Trade will no longer permit the transfer of provisional orders, and offering favourable terms of purchase, &c., if the company be permitted to obtain an order.

Street-box Explosions.—Accidents are reported from the Strand, London, and from Carlisle, each of which was due to an explosion of gas which had accumulated in the conduits. The whole of the supply was temporarily interrupted in the latter case, but no personal injuries were sustained at either place.

Trowbridge.—A London company has asked the support of the District Council to a provisional order for electric lighting in the urban district; a meeting of that Council on Monday last decided in favour of any such scheme being carried out by the Council.

Whitechapel. — On Monday last a conference of representatives of the Whitechapel, Limehouse, Mile End, and St. George's, East, district authorities was held at Whitechapel, to discuss the question of electric lighting in connection with the formation of the new municipality. It was resolved that the London County Council be asked to assist them in preventing the County of London and Brush Company from carrying its provisional orders into effect.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The Tramways Sub-Committee has had under consideration the report by Mr. Dyack, burgh surveyor, and Mr. Bell, electrical engineer, with reference to the extension of the system to Torry, Ferryhill, and the Bathing Station, and the electrical equipment of the existing routes. We have already stated that the total cost is estimated at about £280,000. After discussion, the sub-committee resolved to recommend that the whole of the existing system should be electrically equipped. The estimated cost of this, with the reconstruction of the tracks, is £182,933. Taking up next consideration of the proposed extension to Ferryhill, the sub-committee discussed the matter at some length, there being a good deal of difference of opinion as to the route that should be selected. The estimated cost of this extension is £22,684, and the sub-committee eventually resolved to recommend that it should be carried out, the track to be laid double from Union Street along Crown Street, Ferryhill Terrace, Bon-Accord Street, and Fonthill Road, and a single line thence along Whinhill Road to the railway bridge. This would afford a service to Duthie Park. With respect to the extension to Torry there was less difference of opinion, and it was decided to recommend that the extension should be proceeded with, the route—a double track—to be *viâ* Market Street. This would, as a matter of fact, form an extension of the Woodside and George Street route, and the whole could then be worked as one section, an economical arrangement in respect that one depôt, one repairing shop, and one set of men would suffice for the entire route from Woodside to Torry. The Ferryhill extension would be practically a separate route, but the Corporation has plenty of ground for the necessary depôt. The estimated cost of the extension to Torry by Market Street is £32,552. There has to be added to the cost of the extensions a proportion of the outlay necessary for new cars, which may be kept at £7,772, making the total expenditure on the works recommended £245,941. The sub-committee will this week consider the question of an extension to the Bathing Station.

Bradford.—At last week's City Council meeting Alderman Cowgill moved the adoption of the minutes of the Tramways Committee, which stated that the Committee had reconsidered the question of the tender of Messrs. V. Demerbe & Co., for the supply of rails for the proposed tramways and light railway on their patent principle. In accordance with instructions, the city surveyor had sent a communication to Messrs. Demerbe and Co., asking them if, in case they obtained the contract for rails, they would undertake to have the rails made in England. In reply, Mr. G. Francken, a representative of the firm, had attended before the Committee, and said that the company were prepared to have the rails rolled in England, provided satisfactory arrangements could be made. If, however, time was of importance, it would not be feasible for the rolling to be done here, as neither of the English firms doing this work would undertake to deliver within any reasonably short period. After considerable discussion, it was resolved that the Council be again recommended to accept Messrs. Demerbe & Co.'s tender for the supply and laying, on the "Demerbe" system, of the proposed tramways to Lidget Green, Whetley Hill, and Thornbury, and the light railway to Stanningley. The Council, by a very narrow majority, has adopted the minutes.

Cambridge.—The Special Tramways Committee has reported to the Council advising the promotion of a Bill to alter and extend the tramways, and to adapt them for mechanical traction as soon as purchased, and other incidental powers. Extensions to Chesterton and Romsey Town (length, 4 miles 860 yards) are suggested. The length of the existing system is 2 miles 953 yards. The report has been adopted, and Messrs. Kincaid, Waller & Manville are to prepare plans, together with an estimate of the cost of construction and equipment on the overhead electric trolley system.

Canary Islands.—La Société des Tramways Electrique de Teneriffe (Iles Canaries) et Extensions, is the title of a company which has just been formed in Brussels with a capital of £60,000.

Cardiff.—A deputation from the Cardiff Corporation, including Mr. Harpur, M.I.C.E., borough engineer, has just been to Glasgow to inspect the tramway system.

Cardiganshire.—It is stated that a representative of an electrical firm will shortly visit Cardiganshire to report of the feasibility of connecting Newquay and Llandyssil by means of an electric railway.

Chester.—The Town Council on Wednesday passed a resolution in favour of taking over the undertaking of the tramways company.

Cleckheaton.—The General Purposes Committee has come to the conclusion that it would not be desirable to promote a Bill in Parliament for power to lay down a system of electric tramways in the Spen Valley, under the auspices of the local authorities, but that at the proper time all necessary steps should be taken to secure the insertion in the order for similar powers, which is being sought by the British Electric Traction Company, of clauses for the protection of the interests of Cleckheaton.

Devonport.—The Devonport and District Tramways Company has been absorbed by the British Electric Traction Company. It seems, however, that the old name is to be retained. The company has offered to take a transfer of the powers acquired by the Corporation to construct and work a line to the suburb of St. Budeaux. The Corporation have not yet replied to the offer, but, on the other hand, have decided upon the extension of their proposed lines to Crown Hill, and have in contemplation other developments.

Doncaster.—On 11th inst. at the Board of Trade, Mr. J. F. S. Hopwood, C.B., C.M.G., assistant secretary of the Board of Trade, heard the objections to the amendments proposed by the Great Northern Railway Company to the Light Railways Order of the Corporation of Doncaster.

Dublin.—In the action of Maher *v.* Dublin United Tramways Company last week, an application was made at the Dublin Courts for the case to be remitted for trial before the Recorder. Plaintiff claims damages for injuries sustained through negligence on the part of the defendants' servants. He was run into while leading his horse and coal dray down Mount Bank one day last month. The application was granted.

A tramcar of a novel and picturesque design has just been built by the Dublin United Tramways Company at their works, Inchicore, and is intended for work on the Clontarf line, says a Dublin paper. It is of the vestibule type and affords shelter for both driver and conductor. The platform staircases are enclosed within the vestibules. Access to the roof is made through a "hatchway" above the vestibules. The roof seats are provided with a cover, which will at all times provide a dry seat. This improvement is the invention of a young Dublin citizen.

On 10th inst. the trial trip took place over the new portion of the electric tram line from Kenilworth Square to Ball's Bridge.

The Harold's Cross line was worked by electricity for the first time on Monday. Electric traction was also introduced last week on the Rathmines-to-the-sea line. The work of electrical equipment on the remaining horse car lines is steadily progressing, and the North Quays, Glasnevin, Drumcondra, Sandymount, Palmerston Park, Dolphin's Barn, and Westland Row to Hatch Street lines will be run by electricity on pretty early dates.

Dudley.—On 17th inst. objections were raised at the Board of Trade to the Dudley and District Light Railways Extensions on appeal from the order of the Light Railway Commissioners. The Worcester County Council and the Stourbridge Urban District Council desired certain street widenings to be carried out, but Sir Courtenay Boyle thought, though they might be desirable, they were not a necessity.

Electric Railways.—A *Financial Times* correspondent says that the formation which has just taken place in Berlin under the most favourable auspices possible of the Studien Gesellschaft für Elektrische Schnellbahnen, is a remarkable indication of the determination of the leading German financial institutions, engineering firms, and scientists, not only to advance far beyond the practice of the so-called electric railways in the United States, the electric railways in England, and the somewhat similar projects in Belgium, France, and Italy, but also of their firm intention to ascertain what can be accomplished by means of high speed electric railways for main line and long-distance traffic. To appreciate the force of this statement, it is only necessary to mention that among the formidable and lengthy list of founders and members of the Administrative Council are included such well-known names as the National Bank for Germany, Fred. Krupp, of Essen, the General Electricity Company, of Berlin, and A. Borsig, of Berlin locomotive fame; Siemens and Halske, Dr. Schultz, president of the Imperial Railway Department, Dr. George Siemens and A. Gwinner, directors of the Deutsche Bank, Jacob S. H. Stern, Frankfort-on-the-Maine, and others too numerous to mention. The object of the company is to make experiments with high speed electric railways, in order to determine their financial and technical possibilities to the extent of ascertaining what prospects exist of such main lines yielding interest on an unusually large amount of capital, so as to provide for repayment of principal, and dividends to the shareholders. It is considered that the German railways, as is shown by the increasing use of the lines during the night, have practically reached their full capacity of dealing with traffic,

and it is thought that electric railways, with trains running at much higher speeds than those now obtaining, as, for example, between the cities of Berlin and Hamburg, would probably meet the growing needs of the present day. It is not intended to deal with secondary or local lines, where the low density of the traffic would produce unfavourable financial results, but with main lines where both goods and passenger traffic would be likely to lead to a satisfactory and encouraging revenue.

Glasgow.—Boiler makers and engineers are again protesting against the height of the trolley wires which they want raised so that there may be a free passage for large boilers and pieces of machinery. The Tramways Committee has arranged to leave the wires at the present height, but has resolved that engineering firms may have the wires temporarily removed early in the morning for the transport of their boilers, &c. This offer does not altogether afford satisfaction.

Gomersal.—There is a suggestion that the Bradford Corporation should extend their system from Dudley Hill to Gomersal, and the British Electric Traction Company, which is now seeking powers to serve the Spen Valley, proposes laying down a branch which will serve the village.

Halifax.—The Mayoress of Halifax on 13th inst. performed the duty of starting two turbines which have been erected at the Corporation electricity works. They are of 400 H.P. each, and have been supplied by Messrs. Parsons, of Newcastle, at a total cost of £7,000. It is intended to use them for the tramway service. The chairman of the Electricity Committee (Alderman Woodhead) stated that the enlarged premises would give accommodation for machinery equal to 25,000 H.P. in place of the existing 2,500 H.P.

Hull.—Last week's total takings on the Anlaby Road and Hessle Road, two of the main thoroughfares which have been completed for tram running by electricity at Hull, constituted a record. During the seven days, the total number of passengers carried reached 323,612, and the receipts were £1,348 7s. 8d.

Lancaster.—The Morecambe District Council on Tuesday considered proposals of the Lancaster Town Council for the acquisition of the joint working of the Lancaster and District Tramway Company's undertaking. A sub-committee was appointed to deal with the matter. The scheme is said to include the contemplated working of the cars by electricity in place of horses.

Liverpool.—On Tuesday evening a somewhat serious accident occurred on the electric tramway lines in Upper Parliament Street. A fully loaded 'bus was about to turn round a corner when an electric car, coming behind, crashed into it and turned it on to its side. The occupants were thrown all of a heap, and it is reported that nine persons were more or less seriously injured. The car itself was forced off the line and turned half round.

The city engineer and other Corporation officials have made a trial trip on, and an inspection of, the Walton electric tramway. The Board of Trade sanction is now being sought. The street works from Spellow Lane to Preston Road have been completed ready for the overhead equipment, and the laying of the lines from that point to Aintree is well advanced.

At last week's Council meeting there was a general discussion as to the new lines which are to be constructed, and most of the lines which had been recommended were approved, but the business not being concluded, the meeting adjourned until Wednesday.

An adjourned special meeting of the City Council as to tramways was held on Wednesday for the following purpose:—

To consider, and, if thought expedient, to approve of powers being included in the provisional order authorised by the Council to be applied for to the Board of Trade for the construction of the following additional tramways, viz.:—Tramway No. 40—Great Howard Street, Oldhall Street, Tithebarn Street, and Exchange Street East. The length of this tramway will be about 660 yards double line and 620 yards single line, or equivalent to a length of 1 mile 180 yards of single line. Tramway No. 45—Water Street: The length of this additional single line will be about 600 yards. Tramway No. 48—Chapel Street, Tithebarn Street, Marylebone, Gardner's Row, and Bevington Hill: The length of the single line will be about 1 mile 90 yards. Tramway No. 44—Fontenoy Street: The length of this proposed single line would be about 550 yards.

London.—It is stated in a daily paper that trains may run on the short electrical section of the Metropolitan underground line at Kensington by the end of the month, and by employed for public service two or three weeks later.

Musselburgh.—The Town Council have been asked by the agents for the promoters of the electric tramway between Musselburgh and Portobello to pass a resolution in favour of the scheme. They state that their terms with the Council would practically be, generally speaking, the same as in the case of the light electric railway scheme. The committee were instructed to inquire as to the terms and report.

Newcastle-on-Tyne.—The City Council has considered a report by the new Tramways Committee as to the arrangements for working the tramways after November 11th (the date of the expiration of the present leases) and during reconstruction. The tramways company will work the service from that date to March 1st next, at the present rental of £4,222 per annum, and from the latter date, when the reconstruction will commence, and during the reconstruction and electrical equipment upon other specified terms. The report has been adopted. The committee recommends that tenders for 100 cars be invited, also for street pillars of an ornamental character, similar to those at Leeds and Liverpool, and a car shed at Byker Hill.

Newport.—The Lighting and Traffic and Electricity Committees have decided to take steps for obtaining the permission of Parliament to adopt electricity as motive power on the Corporation tramways. It was tentatively decided that the new power station should be in Friar's Fields, adjacent to the present central station for lighting purposes; and it was resolved that the joint committee report fully upon the whole question. To this end it was decided to call in the services of Mr. Horace Parshall, the adviser of the Thomson-Houston Company.

North Wales.—The Rhyl and Prestatyn Light Railway Company have issued a Parliamentary notice to the effect that they propose making an alteration of the line of route of the electric railway to be constructed between the East Parade, Rhyl, and Prestatyn. It is calculated that about £60,000 will be spent by the company in the Rhyl district on extensions and constructive works.

Nottingham.—A deputation from Nottingham, consisting of Mr. Arthur Brown, city engineer, and Mr. J. Aldworth, manager of the city tramways, has been in Glasgow inspecting the tramway systems.

Oldham.—The Manchester Carriage Company has asked the Tramways Committee to agree not to run the new tramcars until after the expiration of their lease. The committee disagreed to the proposition, but agreed to do as little damage as possible to the company's lines, and to pay compensation for any damage to rolling stock or loss of traffic. The committee will have a conference with the Electric Lighting Committee regarding the work to be undertaken by each committee in connection with the construction of the tramways. A deputation to Liverpool and Birkenhead, to inspect the various tramcars in operation there, has reported having inspected seven or eight different types and designs of cars. Councillor Spencer remarked that from what was said it was time they were putting the matter in form. Everybody seemed to be busy, and the sooner the committee made up their mind the better. The chairman said that one of the builders stated he had refused an order for 250 cars on account of want of time to make them. The borough surveyor will submit at the next meeting a design of a tramcar.

Plymouth.—The Town Council has decided upon a further extension of the electric tramways. This will open up a developing suburb approached from Hyde Park Lane. This extension is likely to be delayed for a few years by the necessity for certain works of street widening, and the Ratepayers' Association are asking that precedence shall be given to an extension of the lines through the town. It is a significant fact that the extension now asked for was, before the advent of electric traction, opposed and defeated by the Association which now wants it carried out.

Portsmouth.—The Tramway Committee has carefully considered the question of the gauge to be adopted for the tramways in the borough, both in the reconstruction of the existing lines of tramway, and for all extensions that may be carried out, and has come to the conclusion that it would be better to maintain the existing gauge of 4 feet 8½ inches. The Council has adopted a recommendation to this effect.

Portugal.—The *Electrical World and Engineer* says that a representative of the firm of Wernher, Beit & Co., bankers, of London, has just been in New York for the purpose of purchasing apparatus and material for the electric equipment of Portuguese tramways. W. B. Rommel has been appointed chief engineer and general manager of the Carros de Ferro del Lisboa (Lisbon Tramways Company). All the requisite equipment and material will be bought in the United States at a cost of $1,000,000. He has already placed contracts with the Lorain Steel Company, of Lorain, O., for 2,500 tons of rails, which will constitute half what will eventually be required for the Lisbon road. The General Electric Company, of Schenectady, will furnish 75 car equipments, and the J. G. Brill Manufacturing Company, of Philadelphia, will supply 120 car trucks. The question of the cars themselves has not yet been decided, and other portions of the electrical equipment are undecided at the moment.

Preston.—A special committee of the Corporation has presented a special report suggesting that the overhead trolley system be adopted in Preston, and that the tramway system be taken over and worked by them.

Rhondda.—The District Council will oppose the application of the British Electric Traction Company, who contemplate running electric trams in the Rhondda Valley, as they have refused to guarantee that certain roads should be widened and the Cymmer Bridge strengthened.

Rothesay.—The Town Council will, at its next sitting, have before it a resolution to approve of the promotion of a tramway or light railway from Rothesay to Kilchattan Bay, *viâ* Scalpsie Bay, by the British Electric Traction Company, reserving settlement of questions of detail.

Russia.—An electric tramway on the Siemens and Halske system has just been completed and put in operation in the town of Shitomer (Volhynien Government). The power station comprises three boilers and three vertical compound engines, each coupled to a 150 KW. continuous current dynamo.

Sedgley.—The British Electric Traction Company have deposited plans at the District Council offices for the reconstruction of the tramlines between Dudley, Sedgley, and Wolverhampton. More than two-thirds of the line runs through the parish of Sedgley, and the British Electric Traction Company, who have acquired the line, are desirous of altering it and substituting overhead electric traction for steam as soon as possible.

Sheffield.—There was a 40 minutes' breakdown of the electric tramway system on the evening of the 16th inst. It is reported in the *Sheffield Daily Telegraph* that the stoppage was due

to a temporary deficiency of boiler power. The available plant at the Kelham Island station is taxed to its utmost working capacity. It seems that it was necessary to overhaul one of the three boilers, and but for the unusually heavy traffic on the cars the two boilers would have sufficed. It is said that the steam-power decreased, the fans went slower, and the pressure could not be recovered. Mr. A. L. C. Fell, the city electrical engineer, was at Kelham Island, and about 8 o'clock he deemed it advisable to shut off the current altogether, in order that the boilers might have a fair chance of recovery. The pressure had then got down to about 40 lbs. to the square inch, and although one or two cars might have been kept running the service would have been defective all night. It was unfortunate that the extra call upon the current came when a boiler was undergoing repair, for if that had been available the difficulty would have been overcome in a few minutes. As it was, all the cars suddenly stopped for 40 minutes. By ten minutes to nine a pressure of 140 lbs. to the square inch on the boilers at the station had been obtained, and the current was on again. The laying down of new boilers at Kelham Island has made good progress. Two will be ready for use in about a month.

Southport.—On Tuesday Mr. A. P. Trotter, Board of Trade inspector, held an inquiry at Southport into an application of the Corporation for power to borrow £66,000 for the purpose of providing permanent electric tramways, and their equipment within the borough. Mr. E. S. Harper, deputy town clerk, explained the nature of the application, and suggested the repayment of the loan in a period of 30 years. Mr. C. D. Tait, electrical engineer, stated that they proposed to lay 7,173 yards of single line, and 1,936 yards of double line. The total expenditure for electrical equipment would be £20,364. There would be 15 cars altogether, nine double-deckers, and six single-deckers. Mr. R. P. Hirst produced the plans of construction. When the Corporation acquired the lines of the Birkdale and Southport Company, they would have a circular route. Mr. Harper stated that the estimated cost of the 7,173 lineal yards of single line would be £20,981; the 1,936 yards of double line £12,436 16s.; alterations to roads, footpaths, and drains, £1,800; car sheds and offices, £6,000; contingencies at 10 per cent., £4,416 3s. 6d.; electrical estimate, £20,364; total, £66,000. At the request of Councillor Travis, the inspector promised to present his report to the Board of Trade as soon as possible, so that the work of construction might be begun at the earliest possible moment.

Surbiton.—The Council has been sitting in committee to consider the questions of electric light and tramways.

Swansea.—In view of the opposition of the local authorities, the Light Railways Commissioners will not grant the Swansea Tramways Company's application for an order to carry out certain extensions.

Switzerland.—The United States Consul at Marseilles reports that the Paris, Lyons, and Mediterranean Railway Company, headquarters at 88, Rue St. Lazare, Paris, has undertaken the construction and operation of an electric railway between Fayet and Chamounix, at the foot of Mont Blanc. The line is, says the *Society of Arts Journal*, to be in operation within 20 months, and it is to be presumed that the company will be interested in propositions for machinery and equipment. Power is to be furnished by the River Arve. The cars are to be automobiles, each supplied with its own motor. The contract for building the road proper and providing the water-power has been divided into two parts and awarded to Gagner & Frères, of Annecy, and Richard & Meynard, of Avignon.

Wakefield.—At their meeting last week the Corporation, on the recommendation of the General Purposes Committee, decided to proceed, by way of a private Bill to be introduced in Parliament during the forthcoming session, for powers to construct and operate electric tramways, and at the same meeting appointed Mr. Robert Hammond, M.Inst.C.E. (who laid down the municipal electricity works there), to prepare the plans and estimates and to undertake the customary Parliamentary work in connection therewith. The scheme embodies about 15 miles of tramlines, and embraces the principal outlying districts and neighbouring towns and villages.

Wolverhampton-Bridgnorth.—The promoters of the Wolverhampton and Bridgnorth Light Railway Company have failed to secure the approval of the Light Railway Commissioners, and the scheme must, therefore, fall through. The Earl of Jersey and Colonel Boughey held the necessary inquiry on Thursday last week. The scheme was supported by the municipal authorities of Wolverhampton and Bridgnorth, and by the local authorities of Claverley, Seisdon, Sedgley and Bilston; but it was opposed by the London and North Western and the Great Western Railway Companies, and by the Earl of Dudley. Lord Dudley's opposition did not apparently count for as much as the opposition of the North Western and Great Western Railway Companies, who put forward various objections to the making of connections between the new line and their respective systems. These objections were put so strongly as to lead counsel for the promoters to argue that even without connections, the line would be better than nothing, the district at the present time being practically without any railway communication. The Commisioners, however, thought otherwise, and hence they decided not to recommend the Board of Trade to grant an order. This has caused general regret throughout a wide district, which has for years stood in need of such a railway as that suggested.

TELEGRAPH AND TELEPHONE NOTES.

The American Pacific Cable.—A Washington telegram states that President McKinley has determined to urge upon Congress the necessity for a trans-Pacific cable. The recent naval survey showed that the route selected is perfectly practicable. We are also informed that the next Japanese Diet will be asked to subsidise the cable company which proposes to lay a line across the Pacific from the United States to Japan and the Philippine Islands. This company undertakes to make a 50 per cent. reduction on the present charge for telegrams.

The Anglo-American Telegraph Company and its Rivals.—We make the following extract from a contemporary:—

"Anglo" shareholders are viewing with something like dismay the progress of the German Atlantic cable now under construction by Messrs. Siemens Bros. & Co. When the "Anglo" loses the traffic from Germany, which will probably be within a year from date, it is calculated that the loss in gross traffic receipts may reach £150,000. Of this we may assume that 25 per cent. would be clear profit. Thus the company stands to lose £50,000 per annum by the loss of traffic from one source alone.

As to the accuracy of the figures given above we have no means of judging; but it is inaccurate to hold Messrs. Siemens Bros., & Co. responsible for making the German cable referred to, and which we assume is that about to be laid from Emden to the Azores. This cable is, we understand, to be made by the Telegraph Construction and Maintenance Company, who, in conjunction with the Eastern Telegraph Company, the Brazilian Submarine Telegraph Company, and a German Company, have already laid one cable from Germany to the Azores, touching at Vigo and Lisbon. It appears now that for some reason another cable direct from Emden to the Azores is required.

Germany and Submarine Cables.—The *Westminster Gazette* says that "at the end of the current month the first cable steamer ever built to German order will be launched at Port Glasgow. When she is completed, a new industry will be added to the already numerous industries of the Fatherland. Hitherto, Germany has played practically no part in the work of laying submarine cables. Henceforward, however, she will probably figure conspicuously in this department of human activity. It is proposed to lay a cable which shall connect Emden directly with New York *vid* Vigo, and cable connection with German South-West Africa is also in contemplation. Further, German firms are under contract to lay cables along the coast of the Balkan Peninsula. The *Cologne Gazette* rejoices exceedingly at the prospect of Germany owning her own lines.

Cable Communication Restored.—The Direct Spanish Telegraph Company, Limited, announce that direct cable communication with Spain, *vid* Bilbao, is now restored.

A Hint to the Commission for Inquiring into Communication with Lightships.—We learn that a successful installation of wireless telegraphy has been established on one of the most dangerous parts of the Ushant coast, between lighthouses some 35 miles apart. The preliminary experiments, says a Brest telegram, have been carried out by Lieut. Tissot, of the French Navy, on behalf of the Government, and the installation connects the lighthouse on the Isle of Ushant with the new lighthouse constructed on the Ile Vierge. Many wrecks have occurred in this vicinity, and the establishment of a wireless telegraphy installation at such a dangerous point must prove of the greatest importance to shipping. Other lighthouses on the French side of the Channel are to be connected in the same way. It is authoritatively stated that up to the present time no definite action has been taken by the English authorities in giving effect to any such precautionary measures between lightships and the shore.

Proposed Iceland Cable.—As may perhaps be remembered, writes a correspondent of the *Financial Times*, the Great Northern Telegraph Company has already expressed its readiness to lay a cable between Denmark and Iceland, a connection which has been discussed for a considerable time past. It is estimated that the cost of installation would amount to 10,000,000 kroner, and the company asks for a subsidy for the maintenance of the cable. The Iceland Althing has already agreed to contribute 35,000 kroner yearly for this purpose, whilst the Danish Government has offered an annual subsidy of £54,000 kroner for a period of 20 years. In addition to these both the Russian and German Governments have agreed to subsidise the cable, but England and France, which are said to be the most largely interested in the scheme by reason of the fishing industries near Iceland, have stood aloof from the project altogether. The scheme has now assumed a new phase, it being at present proposed to lay the cable *vid* the Shetland and Faroe Islands to Reikiavik, and to connect the latter by means of land lines with the most important points on the east and north coasts. It is expected that this plan would necessitate an additional expenditure of 500,000 kroner, but the company is willing to adopt it with the omission of Reikiavik and the substitution of an east coast landing place, whereby the length of the submarine cable would be reduced. Though the modification is not approved in Iceland, it is said that the new scheme will probably be carried into effect.

Pacific Cable.—The *Times* says that Mr. Hogan intended yesterday to ask Mr. Chamberlain whether he is in a position to report any effective progress in the negotiations for the construction of the Pacific cable from Canada to Australia, or of the proposed alternative cable from South Africa to Australia.

(*Continued on page* 643.)

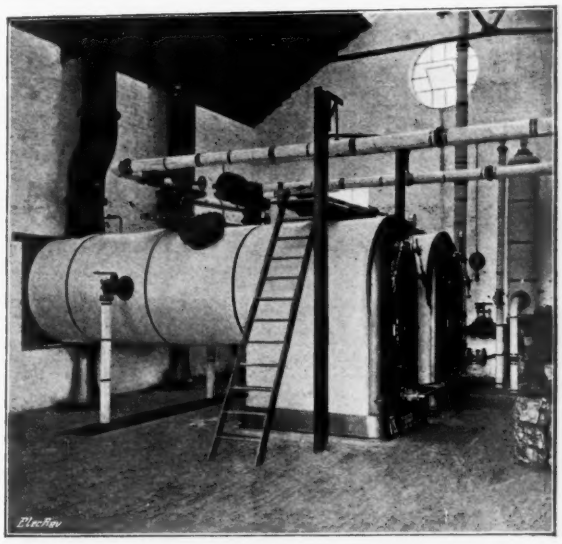
ALDERLEY AND WILMSLOW ELECTRICITY WORKS.

Few of our readers will be acquainted with the district of Alderley Edge; it was formerly known by the name of Chorley. Owing to a town in Lancashire bearing the same name, and to the inconvenience occasioned thereby, the local authority of the district deemed it necessary to change the name, and it was by the consent of the Local Government Board designated "Alderley Edge."

It is a fashionable suburb situated in Cheshire, between Manchester and Crewe, and is readily accessible from either of these towns, the distance from Manchester being about 18½ miles and from Crewe 17 miles. The "Edge" stands some 500 feet above sea-level, and some 300 feet above the surrounding plains, thus affording views of the most pleasing districts of Cheshire.

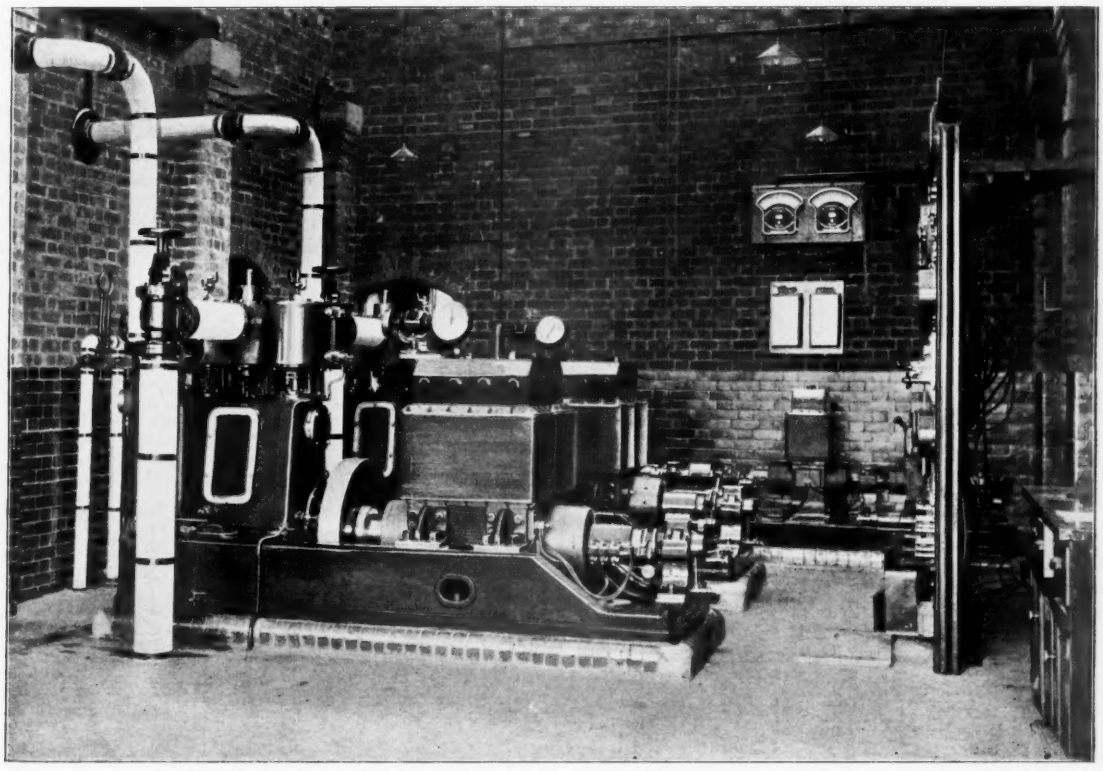
The development of Alderley Edge has been rapid. Since the London and North-Western Railway Company placed the district within easy reach of Manchester and other places, many of the merchants and manufacturers of Manchester have settled there. The business part of the district has also grown considerably, owing to the large increase of residents in the neighbourhood.

The introduction of electric lighting into Alderley Edge so seriously kept back electrical enterprise in the smaller towns and districts in these islands. The Council itself pro-



Boilers.

cured an order, only to transfer it a year later to the same people, who formed a company—the Alderley and Wilmslow



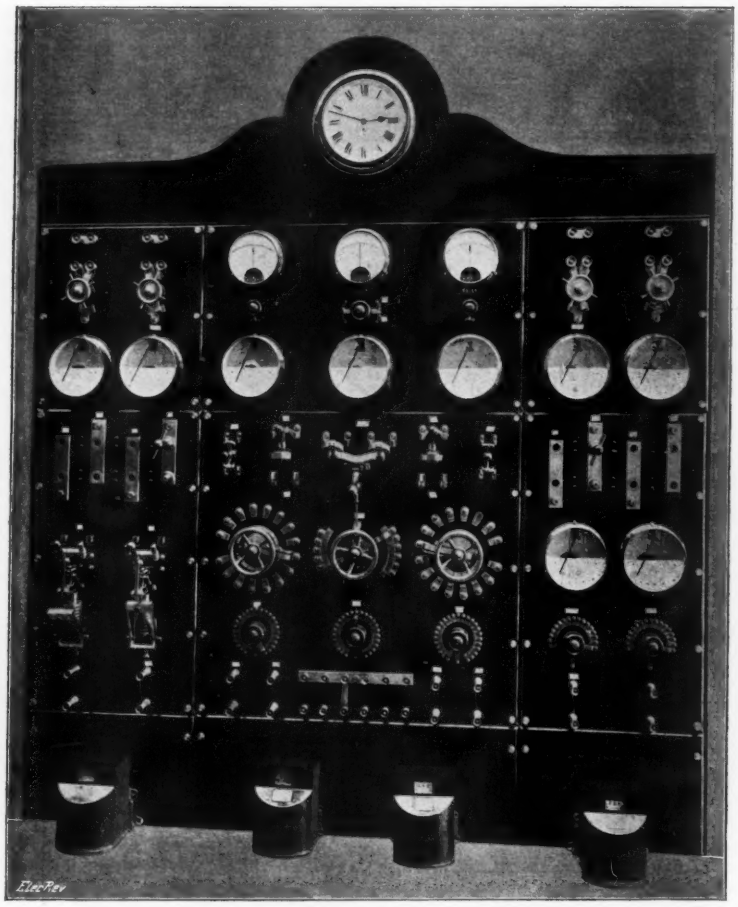
General View of Engine Room.

and Wilmslow was first seriously considered in the year 1889. Nothing, however, was at that time actually done in the matter. In 1894 a proposal was made by a few local gentlemen that an application should be made to the Board of Trade for a provisional order for the supply of electric light to the district, but it was opposed by the Urban District Council, with the same dog-in-the-manger policy which has

Electric Supply, Limited—for the purpose of carrying out the order.

Only a small amount of capital was subscribed when the company first started; they, therefore, placed the contract for the works in the hands of Messrs. Edmundson's Electricity Corporation, who have found practically all the capital for the establishment of the works, and have designed

and executed them throughout in their usual simple but substantial manner.



Main Switchboard.

The district is a compact one, but it was not found possible to obtain a site for the works, except at a considerable distance from the centre, entailing a heavy outlay on feeders; the site was otherwise very suitable, there being ample room for extensions, and water for boiler feed purposes, as well as for condensing, if desired.

The buildings, which were erected by a local firm—Messrs. Isaac Massey & Sons, under the supervision of Mr. W. C. Hardisty, of Manchester—are of a neat and handsome appearance, well lighted and finished. As the roofs consist solely of iron, slate, and glass, and the window sashes of iron, the whole of the buildings are fireproof; even the wiring has been done in iron barrel, so that except for the teak moulding round the switchboard and the doors, there is nothing inflammable inside the walls.

The plant at present installed consists of two Davey-Paxman locomotive type multitubular boilers, of which we give an illustration. Each of these has 610 square feet heating surface, and is capable of evaporating 2,500 lbs. per hour. The fireboxes are of steel, and there are 100 tubes of 2¼ inches external diameter in each boiler.

The steam piping consists simply of a connection between each boiler and one engine, with a cross connection to provide against breakdown. Each boiler is provided with a steel chimney 48 feet high, not because these were preferred to a suitable brick chimney, but on account of objections which were raised to the latter.

The rest of the boiler house equipment consists of two Worthington steam pumps and a Wright's feed heater.

The whole of the steam pipes and boilers are covered with Magnesia non-conducting composition, and the flanges are enclosed in special boxes.

The generating sets consist of two Ediswan dynamos of 46 KW. output at 420 to 460 volts, direct coupled to Belliss engines running at 550 revolutions per minute.

The electrical system is the same as that in use in all Messrs. Edmundson's stations, the supply being on the three-wire system, with 210 volts at the lamps; the main dynamos give 420 to 460 volts, a balancer and a battery taking care of the balance of the system, and the cells are charged direct from the bus bars through boosters.

The balancer is composed of two similar machines coupled together, each armature being capable of dealing with 50 amperes at 210 to 230 volts, and the output of each is regulated by a resistance transferred from the shunt winding of one machine to that of the other by a single multiple-point switch.

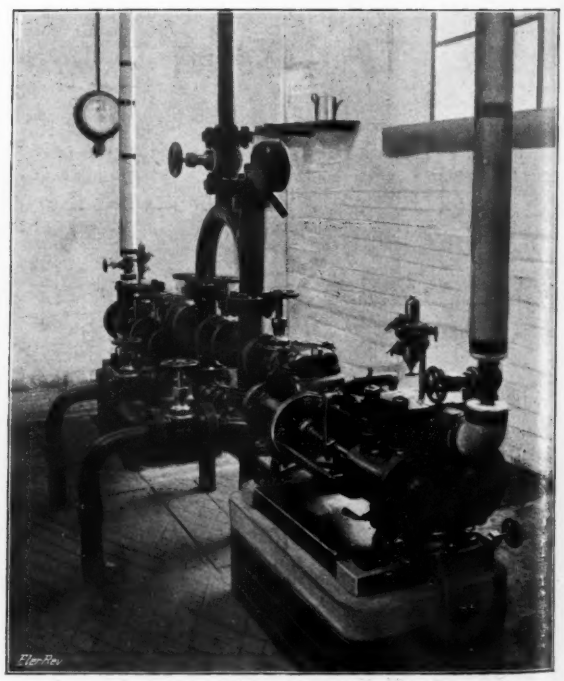
To either end of the balancer are coupled the boosters, each of which is capable of carrying 55 amperes with a boost of 70 volts, a regulating resistance being provided for each field magnet.

An enamelled slate switchboard of Messrs. Edmundson's standard type, composed of three main panels, is placed opposite the present generating sets, and bears the usual switches and fuses for the feeders, dynamos, accumulator, and the starting of the balancing and boosting set. The regulating resistances are placed on the wall at the back of the board, and very ample room has been left for getting at all the connections.

The battery consists of 230 cells of the D.P. type, having a capacity of 60 amperes for nine hours and 90 amperes for four hours.

The whole of the feeders and distributors are of Messrs. Callender's lead-sheathed and steel-armoured type of cable, with extra heavy lead on all sections.

The feeders consist of triple concentric cables; there are at present two feeders

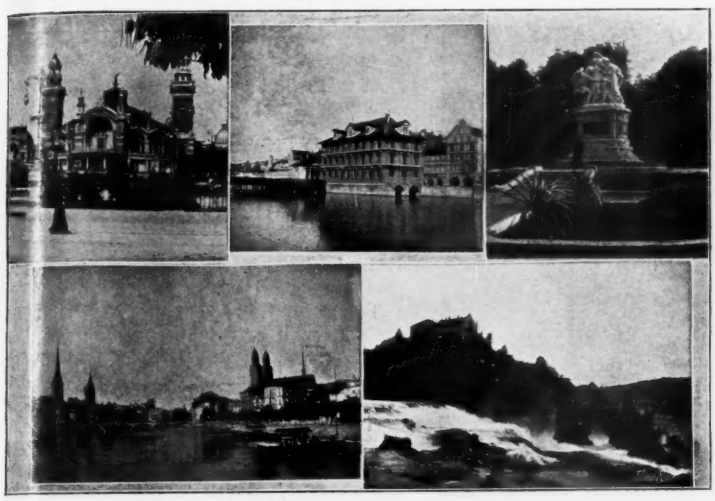


Feed-Water Pumps.

in use, one 1,133 yards in length, of ·1, ·06, ·1 square inch, and the other 1,536 yards long, of ·2, ·1, ·2 square inch cross section.

The distributing network consists of three-core cable, insulated similarly to the feeders, but with the cores laid up side by side instead of concentric. There are about 5,000 yards of ·075, ·05, ·075 square inch laid at present.

Tonhalle, Zürich. Rathaus, Zürich. Group of Statuary, Bâle.



View in Zürich. Schloss Lauffen and Falls of Rhine.

Snapshots from the Swiss Tour.

The feeder and network boxes are of Messrs. Callender's standard type, with connecting links, fitted in brick pits under the pavement.

The house services consist of two-core lead-sheathed and armoured cable, connected on the consumer's premises with Reid's patent fuse boxes.

The charges for supply are based on the "maximum demand" system, at the rate of 7d. per unit for the first hour and 4d. afterwards.

The works were formally inaugurated on the 5th inst.

We are indebted to Mr. H. W. Watts, the resident electrical engineer, and Mr. W. E. Rowcliffe, the secretary of the company, for kindly furnishing us with particulars and photographs of the works for the purpose of this article.

THE ELECTRICAL ENGINEERS' SWISS TOUR.

(*Concluded from page* 589.)

With this, the last instalment of our narrative, we reproduce a few photographs taken during the excursion—not so much for their artistic merit, as for the purpose of giving some idea, however feeble, of the places and scenes visited by the party. For many of these we are indebted to friends, who have kindly lent us photographs.

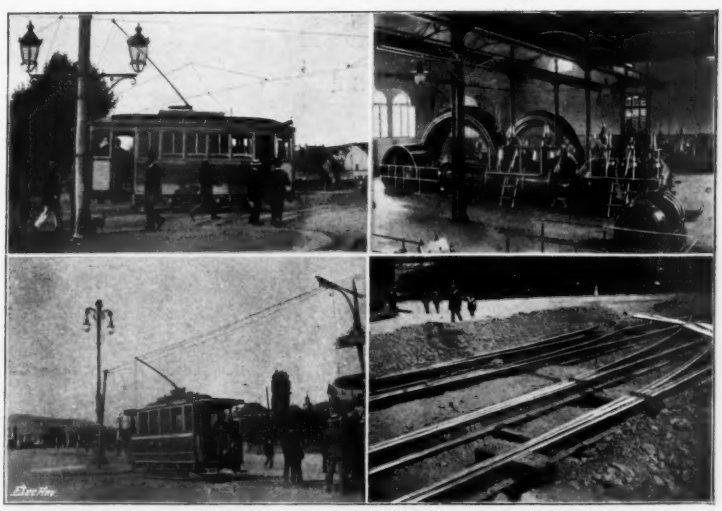
An early start was made on Thursday, September 7th; the unwelcome *reveillé* was sounded at 5.30 a.m., and the party embarked on a steamer at 7.15 a.m. After a pleasant, if chilly, voyage up the lake (Lucerne) to Stansstad, the special trains which were to take us up to Engelberg were boarded and the journey resumed. The line is worked on the three-phase system, with two trolley wires; the current is collected by means of a bow, divided into two parts by an insulating piece. With this form of collector the trolley wires need not be strained at all tightly, and the suspending wires, often in duplicate, are quite slack. The difficulty of ensuring that both wires shall make proper contact when rounding curves is met by clamping them to iron bars of a suitable shape. The rails are of light section, with Chicago bonds, and are carried on iron trough sleepers at metre gauge. The supporting poles are of wood; the suspending wire is generally carried through a hole near the top of the pole, and fixed to a small tightening ratchet, forming a very simple arrangement. The rolling stock consists of seven long bogie cars, each carrying two induction motors of 35 H.P. each, with single reduction gear. The speed is regulated by resistance inserted in the rotor circuit. There are also three locomotives for use on a section of the line laid with Riggenbach rack rails, on a gradient of 1 in 4; each of these is fitted with motors of 150 H.P., and three kinds of brake. The gear can be made single or double reduction, as required. There are two collector bows on each locomotive. The ordinary cars are capable of performing the whole journey unaided, but the locomotives are used to assist them over the steep section.

A halt was made at Obermatt to inspect the generating station and locomotives. There are three generators coupled to high pressure horizontal Bell turbines, with centrifugal governors, running at 550 revolutions per minute. Each generator is of 180 H.P., and is of the rotating armature type, with tunnel winding. There are six poles, and the air gap is about ·5 inch in depth. The generators work at 750 volts, which is applied direct to the trolley wire. For the remote end of the line the pressure is transformed up to 5,000 volts, and reduced to 750 at two transformer stations. All the conductors are overhead, those working at the higher pressure being enclosed in a cage of guard wires where they cross railways or public roads. No oil insulators appear to be used in Switzerland, ordinary double-shed porcelain insulators being considered quite satisfactory.

Besides circuit breakers in circuit with the trolley line, an automatic device is fixed in the station to break the exciter circuits in the event of a heavy short on the line.

The switchboard, as usual, is very simple, with abundant space at the back; this, with all the electrical plant and rolling stock, was made by Messrs. Brown, Boveri & Co.

Zürich-Höngg Tramway. Central Station, Zürich.

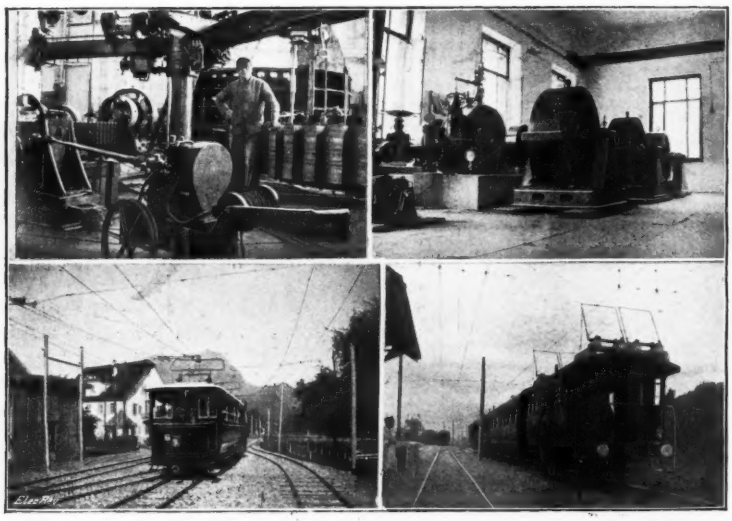


Zürich Tramways. Track Construction, Zürich.

Snapshots from the Swiss Tour.

The journey itself was the first of the series of delightful trips which formed the climax of the tour. Commencing on Lake Lucerne, it led us through the Vale of Stans, rich in historical associations, up wooded ravines alternating with open glades—little huts, or *châlets*, planted everywhere—to the pretty town of Engelberg, sheltered by the mighty Titlis!

Radial Drill and Portable Motor, Oerlikon. Power Station at Obermatt.



Stansstad-Engelberg Railway. Burgdorf-Thun Railway.

Snapshots from the Swiss Tour.

No lingering, however, was possible. The journey was resumed at 12.45, and ended at 9 p.m. at Interlaken.

A brief halt at Stansstad, waiting for the steamer, gave opportunity for a worthy dame to reap a small fortune by providing refreshments, in a state of frantic excitement lest the chance should be wasted! The steamer soon brought us to Alpnach, under the very flank of Mount Pilatus, where a more protracted delay took place; much interest was shown in the rack railway up the mountain, the first, we believe, ever built in Switzerland. The next section of the route was one of the most charming; it led past Lake Sarnen, over the Brünig Pass, to Brienz, through scenery whose grandeur we do not presume to describe. A large part of this stage was accomplished by means of rack railway; the steam engines on the Swiss lines unfortunately burn briquettes, and emit dense volumes of yellow smoke, which remain, obscuring the landscape long after the cause has disappeared.

The steamboat journey from Brienz to Interlaken took place almost entirely in the dark, which was, however, relieved by lightning flickering about the tops of the mountainous banks of the lake, while rain fell steadily.

Next morning, with our usual energy, we set out at 8 o'clock to visit the Jungfrau Electric Railway. At Lauterbrunnen the power station was visited; here there are one 800-H.P. and two 500-H.P. three-phase generators, coupled direct to Girard horizontal turbines, running at 380 revolutions per minute. The generators are of the inductor type, with heavy rotors, and are insulated from the turbines and from the earth. Although the turbines are fitted with automatic governors, the speed has to be controlled by hand. The generators work at 7,000 volts, at which pressure power is transmitted to the electric railway, 4½ miles distant, and nearly a mile higher in level. The pressure is reduced to 500 volts for the trolley lines, and 120 volts for lighting and for the boring machinery. The water supply is derived from the White Lütschine, at a point 2,500 yards distant, with a head of 130 feet. The conduit consists of steel pipe 6 feet in diameter.

Before leaving Lauterbrunnen the entire party was photographed. The journey to Wengern, the junction of the electric and steam railways, occupied about 1½ hours, and was keenly enjoyed by all. Here the party divided, one half going to lunch, and the other proceeding on the electric railway to the Eiger Glacier, a distance of about two miles. As usual, the overhead work consists of two trolley wires, supported by span wires attached to wooden poles, except in the tunnel. Chicago bonds are used for the rail return. The rack is of a pattern designed by Mr. E. Strub. The gradient is 12 per cent. in the open and 25 per cent. in the tunnel. There are four locomotives, each equipped with two 200-H.P. motors, and four trolley poles, two to each wire; these push the passenger cars before them up the gradient. The later locomotives, one of which we saw in Messrs. Brown's shops, are more powerful by 100 H.P. than those first used.

The transformers consist of three vertical cores joined by horizontal yokes; the low pressure winding is inside the high pressure coils. Standing in a sub-station, one realised that, beyond all doubt, the Swiss engineers had "made things hum!"

Arrived at the working face, the visitors obtained access through a side tunnel to a ledge in the face of a precipice, and looked down upon a magnificent rainbow, while an imposing panorama was spread before them. Most of the party scaled the cliff, and reached the top of the Rothstock, a pinnacle of rock, affording a splendid view on all sides; the Jungfrau proper was, however, hidden by the nearer Eiger. The descent was made over a sloping surface of damp snow, not always in the attitude which man regards as his special attribute!

After inspecting the boring machinery, where percussive electric drills are used striking 400 blows per minute, the first section of the party returned for lunch, while the second section proceeded to follow in their footsteps. Here a difficulty arose, owing to the "personal element;" several of those who, as arranged, should have lunched first, before proceeding to the Eiger Glacier, had elected to reverse this order, with the result that about a score of the legitimate members of the first party found themselves compelled to wait nearly an hour before seats at the table were available. This would have mattered little, had it not been that some

View from Wengern. Wetterhorn from Grindelwald.

The Eiger Glacier. On Lake Lucerne.

Snapshots from the Swiss Tour.

of our Swiss friends who were invited to join in the repast, after waiting some time, went away in despair. The apparent slight thus cast upon them was most regrettable.

The same spirit of insubordination, which is the bane of organised visits of this kind, was manifested on other occasions; for example, some members apparently believed that by stubbornly refusing to come off the drivers' platforms of electric cars or locomotives when the time came for starting they could secure those coveted positions for the journey. Much delay, and, we regret to say, not a little annoyance to the courteous officials, was caused by this unseemly conduct.

The return journey from the Scheidegg was made *viâ* Grindelwald, affording a series of magnificent views of the Wetterhorn and the valley of the Black Lütschine.

The morning of Saturday, September 9th, broke somewhat dismally, not only on account of the steady drizzle which was falling, but also because it was the last day of the tour for many of the party. Fortunately the rain ceased before noon.

The first item on this day's programme was a visit to the Kander power station, on the way to Thun. This is a very new station, having been opened last June; it is operated with water-power from the River Kander, and supplies light and power to the towns of Bern and Burgdorf, as well as to the Burgdorf-Thun railway.

The whole river is available, being led through an open canal and a tunnel, each nearly half a mile in length, to a steel pipe 6 feet in diameter. The available head is over 200 feet, and the normal power amounts to 4,500 H.P.

There are four 900-H.P. horizontal reaction turbines, by Escher, Wyss & Co., running at 300 revolutions per minute, and coupled direct to three-phase generators by Brown, Boveri & Co. The latter have rotating field magnets, with tunnel armature, and generate at 4,000 volts pressure, 40 frequency. The exciters are coupled to the generator shafts, and are themselves separately excited by two dynamos driven by turbines.

Automatic governors are to be installed, but at present hand regulation is used, no less than five men being constantly employed in this way.

The power and lighting circuits are kept distinct from one another, the switchboard being specially arranged so as to permit of any generator being thrown on either circuit, and to facilitate repairs without interruption of the supply.

Distribution within a radius of six miles is effected at 4,000 volts; for transmission to greater distances the pressure is raised to 16,000 volts; it is reduced at Bern to 3,000 volts, at Burgdorf to 500 volts, at Münsingen to 4,000 volts, and on the railway to 750 volts. The transformers, of 300 KW. each, are all of the single-phase type, in oil, with water cooling arrangements.

The high pressure lines are carried overhead on porcelain insulators, partly on iron towers, partly on wooden poles. The greatest distance of transmission is nearly 30 miles, and the total weight of copper used is about 100 tons. The whole of the electrical plant, lines, &c., was made by Messrs. Brown, Boveri & Co.

On leaving here the party proceeded to Thun, where lunch was served; afterwards a meeting was held in the Kursaal, this being the last occasion on which all the members would be together. Prof. Threlfall moved a vote of thanks to the President for the gentle, yet firm, and tactful manner in which he had so successfully conducted the tour, and had upheld the dignity of the Institution. Mr. Trotter seconded, and Mr. Raworth having spoken, the motion was carried with great enthusiasm. Prof. Thompson briefly expressed his sincere thanks for the ovation. Mr. Ferranti next moved a vote of thanks to Mr. McMillan, pointing out his untiring energy and skill in organisation, whence he drew happy auguries for the future success of the Institution; the secretary was ably assisted by Mrs. McMillan, who denied herself some excursions for that purpose. Mr. Ferranti also included Mr. Rolph, honorary assistant secretary, who, he said, had been of the greatest assistance.

Mr. Mordey, in seconding the motion, said that Mr. Ferranti knew nothing about it; he (Mr. Mordey) *did* know, and said that Mr. Ferranti was quite right, and was to be congratulated on such good guessing. The President claimed the privilege of joining in the recognition of the enormous amount of work which fell upon the secretary, whose duties were discharged in a manner beyond all praise; the initial suggestion of the trip came from Mr. McMillan himself in committee. The vote was carried with acclamation, followed by choral honours.

Mr. McMillan, in reply, expressed his deep gratitude for the kindness with which he had met, and referred to the untiring assistance he had received from Messrs. Rolph and Tree (the latter of whom had spent many hours overtime), as well as from Mrs. McMillan, who had denied herself sleep for that purpose. Mr. Rolph also replied as well as he could, his voice being, in fact, "used up" with constant answering to questions and shepherding his flock!

The last item consisted of a visit to the Burgdorf-Thun railway, the special characteristic of which is the fact that it is a full-gauge railway, used for some distance in common with steam locomotives, and is operated with three-phase currents. The line is in all 25 miles long, with a maximum gradient of 2·5 per cent.; the rails weigh about 75 lbs. per yard, and are laid on iron sleepers for one-third the length, the rest being wood.

There are two overhead wires, supported by span wires at intervals of 40 yards; these are connected with transformer stations, 14 in number, each of which contains transformers of 150 KW. capacity. There are two electric locomotives, each equipped with two induction motors of 300 H.P., and six bogie motor cars, with motors of 240 H.P., and 66 seats; current is collected by four contact bows, two to each overhead wire.

The speed, which does not exceed 23 miles per hour, is regulated by means of variable resistance inserted in circuit with the rotors. Westinghouse air brakes are used, the pumps being driven by induction motors.

The passenger trains are made up of motor cars and ordinary carriages, the rolling stock being interchangeable with that of the Swiss standard railways. The locomotives are used for goods trains, running at a lower speed. The whole of the electrical plant was made by Messrs. Brown, Boveri & Co.

So like an ordinary railway is this, that the trains blow whistles, and are sometimes—*late!*

Here ended the Swiss tour of the Institution of Electrical Engineers. True, many happy individuals and family parties were able to remain and rest after their exertions, but officially, the tour was over, and the party broke up.

It only remains to express our sincere thanks to the numerous kind friends who assisted us in numberless ways. To them we raise our pen, and cry "Lebs hoch!"

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 638.)

A National Cable System.—The following letter, which was recently addressed to the editor of the *Toronto World*, expresses the views of Sir Sandford Fleming concerning the proposed cable extensions which have recently been so much before the public. Sir Sandford has taken a broad-minded view of the subject, which is in strong contrast to the attitude assumed by the group of cable monopolists who for so long have opposed—ineffectually, we are glad to say—all attempts to serve public convenience by the establishment of a system of cables, which at moderate rates will admit of the ready use of the telegraph throughout our scattered Colonies for social, as well as for business purposes. The letter runs as follows:—

The Lodge, Halifax, *September 26th*, 1899.

Dear Mr. Maclean,—I have the greatest satisfaction in receiving your letter, and on reading the editorial in the *Toronto World* of September 21st, on the subject of a national cable system. The subject is of far more importance than at first sight appears, and I rejoice to know that you have assumed towards it an appreciative attitude. Making telegraphy as cheap as possible, and as free as possible to all classes will not only prove of great public utility in disseminating news for the press, in conferring social advantage, and in promoting the development of trade and commerce, but it will constitute a prime factor in building up, in unifying, and in strengthening our world-encircling Empire.

Less than a year ago I addressed a letter to the Right Hon. Joseph Chamberlain, Secretary of State, on the subject. It appears in the document relating to the Pacific cable, printed last session of the Canadian Parliament. Allow me to refer you to the letter (page 22) in which you will find set forth in brief the history of the land telegraph of the United Kingdom, now an adjunct of the Post Office Department. I pointed out what would result if the same principle of State control, which in that instance has proved such a marvellous success, should be applied to the whole Empire. I think I made it

clear that it is a matter which concerns every British community to be placed in possession of this means of communicating the one to the other, free from the burden of high charges.

The views expressed were most favourably commented on by the whole British press (see pages 31—32 blue book), and it was easily seen that the key to such a system of State-owned cables as that suggested to encircle the Empire was the establishment of the Pacific cable, the great initiatory link in the chain. The pressure of public opinion which followed gave the Pacific cable a decided impulse, and eventually had the effect of increasing the attitude of the Home Government towards the project. Its enemies are, however, very powerful. The Eastern Extension Telegraph Company, finding themselves at last defeated in the Mother country, are now actively engaged in Australia and are making strenuous efforts to frustrate the scheme. By the last mail I learn that this rich monopoly has made overtures to the Australian Government with the view of estranging them from the proposed State-owned Pacific cable. They have formally submitted a proposal to lay a new cable from England to Australia by way of the Cape of Good Hope without any subsidy or assistance, and they further promise to lower charges on all messages. This proposal is put in the most tempting aspect to Australians, and it will be difficult for them to decline it. My own opinion is that while a cable so laid should not be accepted as a substitute for the Pacific cable, the proposal is of great importance and should not be declined. The Australian Governments should, however, reserve the right to take possession of the new cable at a valuation, so that it would be in their power to bring it under State control.

Should the Eastern Extension Company lay a cable across the Indian Ocean under this condition, good would come out of it. At any future time, by giving notice and making payment of its value, the cable could be transferred from the monopolists to government control. It would then with the Pacific cable constitute a large portion of a complete system of State-owned cables round the empire, it would lead to cheap telegraph transmission from the United Kingdom and Canada to the Cape, India and China, as well as to Australia and New Zealand.

You will gather from these few words how much importance I attach to the subject discussed in the *Toronto World's* editorial. I feel that every effort made to nationalise the telegraph system of the empire is in the right direction, and must tend to beneficial results. —Yours very truly,

SANDFORD FLEMING.

P.S.—I have said nothing about a State cable across the Atlantic. I have confined my remarks to the larger question, which embraces every ocean. Yet the Pacific cable safely under way, the other will quickly follow as a matter of course.

Reduction of Rates to the East.—On the question of the cable rates from India to Europe, the Hong Kong Chamber of Commerce has adopted the following resolutions:—

This Chamber having been asked to accord its support to the effort now being made by Chambers of Commerce in India and other Eastern countries to secure a reduction in the cost of telegrams between the East and Great Britain, is heartily in sympathy with the movement and hereby records the following resolutions: (1) That the rate from India to Great Britain, which is now 4s. per word, is excessive and admits of substantial reduction. (2) That the Chamber is of opinion that a reduction of the tariff would be followed by a sensible increase in the traffic. If there is any hesitation on this account, the Government should, as was done in the case of the Australian Colonies, give the Telegraph Companies a limited guarantee against loss of revenue. (3) That the principle of cheap telegrams should follow the concession of a penny post, as it is certain to prove a powerful factor in promoting trade with the Mother Country; and that, so soon as the time seems ripe, an all-British line should be constructed between the United Kingdom and its great colonies and dependencies either by laying a cable the whole distance, touching only at British ports or by completion of the existing landlines.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Bilbao-Falmouth	... Oct. 12, 1899	... ...
Cayenne-Pinheiro	... Oct. 11, 1899	... ...
Corea-Japan	... Aug. 7, 1899	... ...
Jamaica-Colon	... June 30, 1899	... ...
Latakia-Cyprus	... June 20, 1899	... ...
Trinidad-Demerara (1871 original)	Oct. 11, 1899	... Oct. 13, 1899 (Subject delay.)
Do. do. (1891 duplicate)	Oct. 6, 1899	... ...
Landlines.		
Lines from Haiti to Gonaives, Gros Morne, Port de Paix, Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel	Aug. 18, 1899	... ...
Communication with Mafeking	... Oct. 14, 1899	... ...
Puerto Plata-San Domingo	... Aug. 23, 1899	... Oct. 14, 1899
Nicaraguan Government line to Bluefields destroyed ...	... Oct. 6, 1899	... ...
Communication with interior of Venezuela	... Sept. 23, 1899	... ...

London Telephones. — At the last meeting of the Vestry of St. Martin-in-the-Fields, the Postmaster-General forwarded notice, with plan, showing certain streets in the parish in which it is intended to lay new conduits for telephone wires under the powers of the Telegraph Acts, 1892 and 1899. The surveyor was directed to inform His Grace that the Vestry earnestly hoped that the laying of the conduits will be carried out by night, as well as by day, so as to lessen, as much as possible, the inconvenience caused to the public thereby.

At the Strand Board of Works last week, on the question of overhead wires, the Works' Committee recommended that no permission be given to the National Telephone Company to erect wires or spans to infringe the law, but that owing to the inconvenience likely to be caused to the public by the removal of existing wires, it would be advisable to defer further proceedings for three months, for a report as to whether the company are performing their undertaking to proceed with all speed to place wires underground.—The report was adopted.

Rochester Telephones.—Messrs. Bennett and Ward Thomas have asked the Council to support their application for a telephone license, but the Council is not prepared to do so.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—The Council is to invite tenders for electric light cables shortly.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Birkenhead.—November 14th. The Corporation wants tenders for 13 single-deck and 31 double-deck electric motor cars, also for boilers, economisers, mechanical stokers, steam dynamos, booster and battery. See "Official Notices" this week.

Coventry.—October 23rd. A Corporation Committee is inviting tenders for wiring St. Mary's Hall for electric lighting. Specifications, &c., from Mr. L. Beard the town clerk, 10 Hay Lane, on payment of one guinea returnable as usual.

Darwen.—October 25th. The Corporation wants tenders for poles and overhead electrical equipment, also main feeder cables, for electric traction. See "Official Notices" October 6th.

Glasgow.—November 14th. The Corporation wants tenders for two 800-h.p. compound vertical auxiliary engines for the new tramway power station at Port Dundas. See "Official Notices" October 13th.

Glasgow.—November 20th. The Electricity Department want offers for 10 miles of 2-inch cast-iron pipes. See "Official Notices" October 13th.

Great Western Railway.—October 23rd. The Great Western Railway directors want tenders for the supply of 12 months' stores including electric light and telegraph sundries. See our "Official Notices" October 6th.

Holland.—October 23rd. Tenders are being invited until the 23rd inst. by the municipal authorities of Amsterdam, for the supply of the conductors and apparatus required in connection with an installation of electric lighting in the Entrepot Communal de Commerce. Tenders to be sent to L'Administration Communale, Amsterdam, whence particulars may be obtained.

Hoylake and West Kirby.—November 15th. The Council is wanting tenders for Lancashire boilers, superheaters, economiser, steam engines, alternators, motor alternator, crane, wiring, steam, &c., piping, switchboards (high and low tension), batteries, transformers, concentric mains, &c., &c. See "Official Notices" October 13th.

Islington.—October 25th. The Vestry wants tenders for a secondary battery of 60 cells (1,000 ampere-hours capacity). See "Official Notices" October 6th.

Llandudno.—November 6th. The Council wants tenders for three 150-kw. high speed engines and dynamos, also motors and boosters. See "Official Notices" to-day.

London.—October 23rd. The Post Office is inviting tenders for Swedish, Norwegian, or Finland red fir telegraph poles, and for creosoting them with 10 or 12 lbs. of creosote to the cubic foot. Particulars, &c., from Mr. C. E. Stuart, controller of stores, G.P.O., London.

Maidstone.—November 6th. The Corporation wants tenders for steam dynamos, balancers, boosters, boilers, economiser, surface condenser and feed pumps, switchboard, &c., battery, crane, mains, arc lamps and posts, and electricity meters. See "Official Notices" this week.

Middlesbrough.—November 22nd. The Electric Lighting Committee wants tenders for condensing plant and pipe-work for the electricity works. See "Official Notices" this week.

Morecambe.—The Urban District Council wants tenders for boiler, steam dynamos, switchboard, transformers, mains, pumps and condensers, and storage batteries for electric lighting extensions. See "Official Notices" October 13th.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

St. Pancras.—The Vestry wants offers for the supply of temporary generating plant for the Regent's Park electricity works. See "Official Notices" this week.

Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warsaw.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Warsaw, stating that tenders are invited by the municipality of that city for the construction of freezing chambers and electric lighting in the covered market halls. The latest date by which the tenders have to be sent in has not yet been fixed. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Wigan.—October 25th. The Corporation wants tenders for feeders, mains, water-tube boilers, superheaters, stoneware conduits, steam dynamos, boosters, motor balancers, battery, inspection boxes, &c. See "Official Notices" September 29th.

Wigan.—October 25th. The Corporation wants tenders for cast-iron boxes, frames, &c., (about 30 tons); cast and wrought copper (about three cwt.); brass castings (about one ton). Particulars may be obtained from the borough electrical engineer (Mr. H. Collings Bishop) on payment of one guinea.

Wrexham.—November 8th. The Council wants tenders for boiler house plant, engine house plant, dynamos, switchboard, mains, posts, battery, meters, crane, and buildings for electricity works See "Official Notices" October 13th.

CLOSED.

Carlisle.—The Corporation has placed the contract for switchboard extension with the Electric Construction Company, at £995; that for the steam piping extensions has gone to Messrs. T. Piggott & Co., at £1,028.

Glasgow.—The Electric Tramways Committee have accepted the offer of the Gloucester Carriage and Wagon Company, Limited, to supply 80 bodies for the double-decked electric cars which are being constructed at Coplawhill. The car bodies are to be delivered gradually during the next 12 months.

Glasgow.—The Corporation Tramways Committee, with its usual patriotism, has placed the contract for steel work for the Port Dundas electric power station with Messrs. Ritter, Conley and Co., of Pittsburg, U.S.A. They were the lowest tenderers, the amount quoted being £25,000. It seems that the other offerers were from British firms, who quoted £32,484, £35,085, and £39,650 respectively. We suppose the fact of the matter is, that British steel manufacturers are so up to their eyes in work, that to cut prices would be altogether absurd, especially as quick delivery is presumably a feature of the contract. The same committee recommends the placing of a contract for two sets of electric cranes with the Clayton Manufacturing Company, of Manchester. These matters were to come before the Corporation yesterday (Thursday).

Hackney.—The Hackney Vestry at their meeting last week had under consideration the report of their consulting engineer, Mr. Robert Hammond, on the tenders received for the generating plant required for the municipal electricity works. The following is a list of the tenders received, that of Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, for £22,735, being accepted:—

Name of firm.	Engine.	Dynamo.	Amount of tender.
			£
British Schuckert Elec. Co., Ltd.	Allen	Schuckert	*18,409
Easton, Anderson & Goolden, Ltd.	E. A. & G.	E. A. & G.	*18,735
Yates & Thom	Yates & Thom	None	19,470
British Schuckert Elec. Co., Ltd.	Willans	Schuckert	*19,532
W. H. Allen Son & Co.	Allen	Schuckert	*19,616
British Schuckert Elec. Co., Ltd.	Allen	Schuckert	*20,200
Do. do. do.	Willans	.. .. ..	*21,324
Dick, Kerr & Co., Ltd.	Willans	Elecl. Equipment Synd.	21,408
J. H. Holmes & Co. (*Accepted*)	2 Belliss / 2 Willans	Holmes	22,735
D. Bruce Peebles & Co.	Belliss	Peebles	22,870
Do. do.	Willans	Peebles	22,907
Johnson & Phillips	Allen	J. & P.	23,090
Electric Construction Co., Ltd. ..	Belliss	E. C. Co.	24,268
Read, Holliday & Sons, Ltd. ..	Peache	Read-Holliday	24,000
Electric Construction Co., Ltd. ..	Allen	E. C. Co.	24,320
Westinghouse Electric Co., Ltd. ..	Belliss	Westinghouse	24,729
Do. do. do.	Willans	Do.	25,092
Electric Construction Co, Ltd. ..	Willans	E. C. Co.	25,367
P. R. Jackson & Co., Ltd.	.. .. ..	.. .. ..	26,595
Brush Electrical Eng. Co., Ltd. ..	Universal	Brush	28,359
Thos. Metcalfe, Ltd.	Metcalfe	Schuckert	30,764
Read, Holliday & Sons, Ltd. ..	Victor Coates	Read-Holliday	31,445
British Schuckert Elec. Co., Ltd.	Musgrave	Schuckert	36,272
Westinghouse Electric Co., Ltd. ..	Musgrave	Westinghouse	41,086

* Conditions of specification not accepted by tenderer.

Hull.—The Guardians of Sculcoates Workhouse have accepted the tenders of Reame, Nokes & Co., Hull and Middlesboro, for the electric lighting and telephone work.

Ilfracombe.—We have just received the following list of the tenders submitted to the Council for electricity works:—

Section A.

	£	s.	d.
Rowland & Co. (Morrin Climax)	1,796	19	0
Babcock & Wilcox	2,243	0	0
Stirling Boiler Company	2,674	0	0
Haythorn	3,290	0	0

Section B.

Electric Construction,	Willans engines	£6,248
" "	Belliss "	6,451
Mather & Platt,	Belliss "	6,331
" "	Willans "	5,981
Willans & Robinson	Own "	5,887
Read-Holliday,	Belliss "	5,877
" "	Willans "	5,643
British Schuckert,	.. ..	5,696
Brush Company,	Raworth "	5,449
Thomson-Houston Company,	Belliss "	5,745
" " "	Willans "	5,461
India-Rubber Company,	.. ..	5,414
Alley & Macllellan,	Own "	5,338
Thomas Parker,	Willans "	4,960
" "	Alley-Macllellan engines	4,762
" "	Reavell engines	4,492
Crompton & Co.,	Willans "	4,380
" "	Peache "	4,020
" "	Allen "	4,550
General Electric Company,	Willans "	4,864
" " "	Alley-Macllellan engines	4,652
Parsons,	Turbine engines	4,607
W. H. Allen & Co.,	Own "	4,503

Section C.—Switchboard.

Electric Construction Company	£925
Thomson-Houston Company	818
General Electric Company	779
Jas. White	674
Thos. Parker	671
Edison-Swan	625
B. Thomas	578
R. E. Crompton & Co.	555
Cowans	535
Veritys	501
Middleton	478

Section D.—Underground Mains, Arc Lamps, &c.

British Insulated Wire Company	£3,323
Glover & Co.	3,282
Western Electric Company	3,013
St. Helens Cable Company	3,010
Callender & Co.	2,781

Section F.—Accumulators.

	Battery.	Maintenance.
Ashmore Brown	£938	£45
Tudor Company	935	75
D.P. Company	917	—
Pritchetts & Gold	844	40
Chloride Company	695	35
E.P.S.	658	56
Hart Battery Company	584	28

Section G.—Crane.

Higginbottom	£175
Rogers	147
Spencer	140
Carrick & Ritchie	135

Perth.—A slight slip seems to have occurred in our announcement of the Perth accepted tenders. Messrs. D. Bruce Peebles & Co., have received the complete contract for steam dynamos, motor generators, balancer and booster at £6,110.

FORTHCOMING EVENTS.

Monday, October 23rd.—Yorkshire College Engineering Society, Leeds. President's address and inaugural paper on "Workshop Training with Technical Education," by Wilson Hartnell, M.I.M.E.

Friday, October 27th.—At 5 p.m. Physical Society meeting at the rooms of the Chemical Society, Burlington House. Agenda:—"The Magnetic Properties of the Alloys of Iron and Aluminium," by Dr. S. W. Richardson. Exhibition of a model illustrating a number of the actions in the flow of an electric current, by Mr. G. L. Addenbrooke. Repetition of some experiments with the Wehnelt interrupter devised by Prof. Lecher, by Mr. W. Watson.

Saturday, October 28th.—Manchester Association of Engineers. Mr. J. S. Raworth on "Generation and Electrical Distribution of Motive Power."

NOTES.

The Electro-Harmonic Society.—For the concert of Friday evening next a very good programme has been arranged. The "Anglo-Saxon" singers have been engaged, Mr. George Nelson will play on the "glassophone," Mr Gatehouse will perform on the "wee sinfu feedle," Messrs. George Robins and George Schneider will present humorous sketches, and, as usual, Mr. Izard will preside at the pianoforte.

Obituary.—P. B. Elwell.—Our special correspondent at Sydney, writing on September 12th, informs us with very great regret of the death of Mr. Paul Bedford Elwell, M.I.C.E., M.I.E.E., &c., electrical engineer to the New South Wales Government Railway Department. "Some three years ago," he writes, "Mr. Elwell had an illness which necessitated amputation of the leg, and after the operation the doctors said that if there was no sign of the disease in the system within three years he might reasonably hope to be entirely free for the remainder of his life. Unfortunately in January last, just when the three years had expired, Mr. Elwell was struck by the motor of a steam tram as he was crossing the line in Phillip Street on his way to his office, and was hurled some distance. The tram was coming out of the yard at a faster pace than usual, and ordinarily there would have been plenty of time for even Mr. Elwell, hampered as he was, to have got out of the way. The blow brought on the old trouble, and though he was able to continue his official work up to within a few days ago, and up to the last couple of months to attend at the office, since then the growth of the disease has been so rapid that he succumbed on Sunday, September 10th, sincerely regretted by all who had come in contact with him. Mr. Elwell's death is a great loss not only to the electrical community but to New South Wales, and especially to Sydney, as it is almost entirely due to his efforts that electric traction is the order of the day in New South Wales. He always took a great interest in the Electrical Association of New South Wales, and was one of the early presidents, and has been for many years an active member of the Council of that body, besides contributing several interesting and valuable papers. His last paper, read on May 5th last, 'On the Utilisation of Electric Energy from Intermittent Sources,' brought forth one of the most interesting discussions in the annals of the Association. Mr. Elwell instituted many important improvements in the working of the signalling system on the railways, the earlier portion of his engagement with the Railway Commissioners being devoted to department of his work; latterly the greater part of his time has been absorbed in dealing with electric traction, and so successfully has he dealt with the question, that though the development has been slow, it has been certain; all new lines constructed here in recent years are worked electrically, and it has culminated in the decision of the Railway Commissioners to convert the whole of the existing tram lines to the electric system, and the inauguration of the fine power house now in course of construction at Ultimo, the design of which Mr. Elwell is, of course, mainly responsible for. Mr. Elwell's death is perhaps the more to be regretted, inasmuch as a few days more will see the completion of the first part of this grand work, and the opening of the long-looked for George Street tramway line as, though it has not yet been opened for traffic, September, 18th has been set down for the commencement of the official running; but there still seems to be some doubt as to whether everything will be completed and tested by that time. The overhead conductors, of fig. 8 section, are in place, feeders drawn into the Callender conduit, switchboard in position, and engines and dynamos erected and steam connected, and one of the engines has been under steam and run up to speed. It is intended to run all the North Sydney lines from the power house at Ultimo, and for this purpose a pair of steel-taped Callender cables, 61/13, have been laid in the harbour from Dawes Point to Milson's Point to act as a feeder in duplicate, though the Callender conduit is not yet completed to Dawes Point. The conversion of the Milson's Point line is practically completed, and will be ready for running as soon as power is available from Ultimo; it is intended to use the harbour water for the return circuit, experiments in this direction having been carried out for some time past by the Railway Department. The permanent way has been practically relaid, new sleepers having been laid between Milson's Point and Ridge Street, the present terminus of the cable tram. A trial run was made recently, and as it was made at night, after the ordinary traffic had been stopped, five incandescent lamps were arranged at the end of the trolley pole, in order that the overhead arrangements might be inspected, especially the behaviour of the trolley when passing curves, &c.; power was obtained from the generators at present running the Mosman and Willoughby tram service."

H. Y. Castner.—The death has just occurred in New York State of Mr. Hamilton Y. Castner, of Castner-Kellner celebrity. It is about 12 years since Mr. Castner came over from his native land to work his patent process for manufacturing alkali—metal sodium. His process for the manufacture of aluminium was the means of reducing the price of that metal to what was then a remarkably low figure. One of his schemes, which proved perfectly successful, was the production of sodium on a large scale, but, as the *Times* remarks, perhaps a more important work accomplished by Mr. Castner was the establishment on a manufacturing scale of a process for the electrolytic production of alkali and bleaching powder from common salt. This discovery of a practical and economic method of applying electricity to the decomposition of common salt is of the highest commercial importance, and Castner's process bids fair to eclipse altogether the purely chemical reactions by which hitherto these two products, so essential to the well-being of modern society, have been obtained. It is interesting to note that these two great improvements in industrial chemistry have been carried out by the genius of an American citizen, working in England and supported by the help of English capital, and by the co-operation and advice of English business men and men of science.

J. Tough.—We regret to announce the death of Mr. J. Tough, A.I.E.E., at the early age of 48. He was not, perhaps, so well known to employers as to the employed, as his energies were mostly expended within the factory walls of quite a number of contractors. Commencing as a working mechanic, he was in those days one of the best specimens of his class, and for hard work, indomitable energy, good nature, and fair dealing between master and man he had few equals. By his own industry he raised himself to very good positions, and we feel that his death leaves a distinct gap in the ranks of the few men who have the interests of their employers as well as their own at heart. In the pioneer days of electric lighting Mr. Tough was engaged with the Maxim-Weston Company; latterly he has been in the employ of Messrs. Gwynne & Co., of Brook Street, Holborn. Mr. Tough was a man of sterling character, and to his widow and children we offer our sincere sympathy in their distress.

Vice-Admiral Colomb.—By the death of Vice-Admiral Colomb, at the age of 68 years, we have lost far too soon one of our greatest naval authorities. His experience in the service dates back to 1846, and in 1886 the age limit compelled his retirement from actual office, although he has subsequently rendered valuable assistance in dealing with important matters connected with naval work and life. He will be remembered by those of our readers whose memory carries them back to the early days of the electrical industry as a partner of the late Colonel Sir Francis Bolton, who was one of the founders of the Institution of Electrical Engineers.

The Safety of Electric Motors.—We quote the following interesting editorial note from the New York *Electrical Review*:—"What a holding up of the hands in horror there would have been 10 years ago if anybody had suggested electric motors as the prime movers of a powder mill! Yet the art of constructing these machines has advanced so far that the induction motor is to-day considered the safest power machine for such uses. The equipment of the new powder factory of the United States Navy Department is of interest in showing the feeling of safety that has been engendered by the perfection of the electrical transmission and distribution of power. The induction motor has been said to be 'as simple as a grindstone.' Likewise it is as sparkless as a water-wheel, and in a dangerous place like a powder factory, as safe as a block of ice."

Lectures.—At the meeting of the Birmingham Sunday Lecture Society on 15th inst., Councillor Lancaster gave an address, illustrated by lantern slides and experiments, entitled "One Hundred Years of Electrical Discovery." Mr. A. C. Osler presided.

Prof. S. P. Thompson commences a course of six lectures on "Polyphase Machinery" on Monday evening, October 30th, at the Finsbury Technical College. For particulars see our "Official Notices."

A Forty-Mile Aluminium Wire Transmission Line.—A short illustrated paper read by Mr. Perrine before the Pacific Coast Electric Transmission Association, on tests and calculations of the 40-mile aluminium wire two-phase transmission line of the Standard Electric Company, of California, from the Blue Lakes power house to the Stockton sub-station, is printed in the *Journal of Electricity* and abstracted in the *Electrical World* Digest. The line was designed to deliver 1,000 KW. at 8·8 per cent. loss. The wire is 294 mils in diameter, weighs 4,194 lbs. per mile, and the ultimate tensile strength is 1,539 lbs., or 22,700 lbs. per square inch; the stress at 1 per cent. elongation is 800 lbs.; the conductivity by dimensions is 59·9 per cent. of Matthiesen's standard for soft copper. No elastic limit is given, as it is not well defined in aluminium. The wire was strung in warm weather and had been subjected to extreme cold, but the measurement of the whole resistance of the line showed that it had not stretched. The resistance was found to be 92 ohms, which corresponds to 42·8 miles. Tests were made of the insulation and the condition of the wire during extremely bad weather. The insulation of one wire from earth was found to vary from 160,000 ohms on a rainy day to 44 megohms on a clear day. On one day, during a shower, the line varied in a couple of hours from 5 or 6 megohms down to ¼ megohm, but under no conditions fell below 160,000 ohms. An interesting effect of the self-induction and capacity was observed, namely, that it overcompounds the step-up transformers. The step-up ratio is 2,300 to 25,000 and the step-down ratio 23,000 to 2,200 with a possible range of 200 volts in the regulator, but when current was put on the line without any load, the voltage rose completely beyond the range of the regulator, which seemed impossible with 25,000 volts initial; the voltage at the step-down station showed 27,000 on the line. There is a rise of potential at the end of the line due to the capacity, but it is only 200 volts, and a rise of over 2,000 was observed, which was entirely due to the transformers. A calculation from the constants of the transformers accounts for all but 200 volts of the rise, and an error in calculating the angle of lead in the transformer may account for this. This effect is explained by simple diagrams.—In the discussion which followed, Mr. Lee gave some further information as to aluminium and described a very simple joint. It is merely a flattened aluminium tube, the two wires being laid side by side and twisted up in the same way as in the McIntire joint. Mr. Cory gave the results of some mechanical tests made in the laboratories of the University of California. Joints were tested which had been made by the linemen on the Stockton line. It was found in every case that the line itself gave way before the joint, showing that at least with joints made recently, the strength is greater than that of the wire. This wire had not been strung, so that it had not been subjected to any mechanical strain or continued vibration.

Appointments Vacant.—The Stockton-on-Tees Corporation wants a resident electrical engineer for the electricity works at £250 per annum.

The Manchester Tramways Committee wants an electrical engineer to assist in the erection of the overhead electrical equipment of the tramways. See "Official Notices" this week.

The Bury Electric Lighting Committee wants an assistant distributing engineer and a meter inspector. See "Official Notices."

The Manchester Corporation wants a steam assistant, a mechanical assistant, and a mains engineer for the electricity supply department. See "Official Notices."

The Hastings Corporation wants an assistant electrical engineer at £120 a year. See "Official Notices."

The Wakefield Council wants a city electrical engineer at £250 a year.

The Blackpool and Fleetwood Tramroad Company wants an engineer-in-charge. See our "Official Notices."

University College, Liverpool.—The Governors of the University College, Liverpool, have received a cheque from Mrs. George Holt and her daughter, Miss Emma Holt, for £5,000 each, to be devoted to the purposes of the physical laboratory.

Central Station on Wheels.—The Eastern Railway Company, of France, is utilising what *L'Industrie Electrique* calls a central station on wheels for repairing the Torcenay tunnel. It is mounted on a railway truck, says our New York namesake in an abstract, and includes a petroleum engine driving a dynamo, which furnishes current both for propelling the truck by means of a motor and for lighting the works in the tunnel. This little central station suffices for four to six arc lamps, or 20 to 40 incandescent lamps, and it has been found of great service in tunnels and for night work. Our Paris contemporary also states that in Germany trials are being made with an ambulance carriage built on similar lines. It is provided with a 5-H P. petroleum engine, with sufficient fuel to run 15 hours, driving a 63-volt 40-ampere dynamo, and is furnished with a powerful projector.

Magnalium.—This is the name of a new alloy of aluminium and magnesium, discovered by Dr. L. Mach, which is said to possess valuable properties. The addition of magnesium in quantity not exceeding 30, and not less than 10, parts by weight to 100 parts by weight of aluminium, imparts to the latter metal properties which, in the pure condition, it does not possess, without raising its specific gravity (2·64), on the contrary, slightly lowering it, since the specific gravity of magnesium (1·74) is even less than that of aluminium. The addition of magnesium produces an alloy which is harder, and is easier and cleaner to work than pure aluminium. Turning produces a surface as bright as a mirror, and shining like silver, the metal coming off in long spiral turnings. The alloy files clean and regular, without tearing, or choking the file, as aluminium does. Deep and sharp screw threads can be cut on it, and very clean holes can be bored out. The colour of the metal resembles silver more than aluminium, and it takes a high polish. The hardness and strength of the alloy are considerable; the hardness can be varied by varying the proportions of aluminium. An addition of heavy metals is not only unnecessary, but is positively injurious, since this deteriorates its working properties, and increases its specific gravity. Previous attempts to make useful alloys of aluminium and magnesium are said to have failed, owing to the aluminium not being pure. This point is of great importance, and aluminium made by an electrolytic process must be used.

The Dowson Gas Station at Oerlikon.—There is at Oerlikon, for the electrical driving of a tramway, a station in which there is a 200-H.P. gas generator, and two of 100 H P., with three boilers of 200 H P. The generators burn Belgium anthracite from Liege. The gas is washed, and scrubbed through coke and sawdust. Three engines of 125 H P. drive each a four-pole 550-volt generator at 180 revolutions in combination with 280 Tudor cells in parallel with the dynamos, the regulator cells being charged by a motor-generator, and on the switchboard is an automatic cell switch to regulate the pressure. The apparatus comprises two heavy solenoids. The coal per effective horse-power is stated to be 1·4 lb. Each tram runs 100 miles daily, the line being five miles long, with 20 cars, of which only 10, as a rule, are running. The trolley wires are 8 mm. copper, suspended from span wires carried by Mannesmann steel tubes, or fastened to brackets and single poles. The feeders are placed between the rails and connected to the overhead system every 200 metres. Plastic rail bonds are employed. Each car carries two 25-H.P. motors, geared 1·45, and running at 450 revolutions per minute, with series parallel controllers. Speed is limited to 15 miles per hour.

Personal.—Mr. W. D. W. Lyons, who has just retired from the Finance Department of the Board of Trade, will continue to carry on his duties as Board of Trade auditor of the accounts of electric lighting companies.

Mr. J. W. London, for many years manager of the Douglas Southern Electric Railway Company, has left the island to take up the managership of the Norwich Electric Tramway Company.

Use for Gas Engine Waste Heat.—Mr. O. F. Allan points out in the *Gas Engine* that gas engineers reject from 20 to 50 per cent. of the heat supplied to them by allowing it to pass off with the water of the jacket. This is so far an unavoidable loss as regards the engine, but it need not be all loss. He suggests that by means of a thermometer in the outlet of the jacket, the best temperature for each engine might be found approximately and adhered to. But even at the best there is still much waste heat, and he suggests it might often be used in the shape of hot water for the domestic supply. It may be used in radiators to warm houses, in public buildings for the same purpose, and so on. In manufacturing establishments economy is secured. Thus at the dye works of Mr. Porrit, of, we believe, Cleckheaton, a Thwaite producer plant supplies gas for the motive power engine, and no avoidable waste is permitted. The jacket water goes to the dye vats, and is thus entirely used, and the total fuel consumption has become a negligible quantity, as compared with the previous coal consumption with boiler and steam engine. Yet gas engines driven by producer gas are as yet comparatively scarce, and millions are thrown away annually in waste gas, and waste heat of all descriptions, for lack of the means or spirit to utilise them. We think that many schemes for utilising waste heat might be inaugurated, were it not for the inevitable opposition of the local authority possessing streets to be crossed. A whole London square, for example, with a central garden could easily be supplied with heat, water, and electric light and power from a comparatively small station. Such an installation would be capable of being exploited at a minimum of waste, yet no one attempts to do it, perhaps because the scheme is so palpably sound that the ordinary suspicious landlord company thinks there must be some knavery at the back of what he cannot criticise. It is supposed to be sound practice to locate a supply station out of town. Yet this view is only sound so long as the waste of 90 per cent. of the fuel-heat is looked on as justifiable simply because it is not convertible into power, as though there were no call for hot water. Half the labour of ordinary housekeeping in these days of impossible domestics would be solved by a public supply of hot water and the use of electricity for cooking, or even gas, which cannot as a rule afford a cheap source of heat for heating large quantities of water for baths, &c.

Army Reserve Men.—The Chloride Electrical Storage Syndicate, Limited, in whose service a number of army reserve men are employed, have resolved that for a period of three months half pay should be paid weekly to the wives and families of army reserve men in the syndicate's employ called on to rejoin the forces during the present crisis, and employment assured the men on their return.

Is Brilliant Public Speaking any Criterion of Engineering Ability?—Several members of the Institution party to Switzerland expressed surprise at the brevity of the speech which Mr. C. E. L. Brown read at the luncheon in the Ton Halle, Zürich. In England, and especially in electrical circles, we are, perhaps, too much given to judging a man's abilities by the sort of speech he can make. Mr. Brown's speech simply showed that he was what he professed to be, a *practical* electrical engineer. There are many such in this country amongst the young men who have been quietly doing the work of our electrical engineering companies during the last few years. They only want encouragement and opportunities to raise our profession into the front rank. The sort of language that one is accustomed to use by long contact with the staff and workmen of an engineering factory will hardly pass muster in a public meeting, and this is the reason why a man who can explain a drawing or piece of apparatus to a foreman in a few telling sentences, will have considerable difficulty in expressing himself in a public hall. Will the members of the Institution therefore please remember during the coming session that the man with the provincial accent or halting speech may have useful practical information to impart. Jokes and quibbles on word endings, &c., are all very well, but that sort of thing does not carry us much "forrader."

Proposed Assembly of Scientists at Paris in 1900.—The British Association for the Advancement of Science has followed up the fraternising of English and French scientists at Dover by setting on foot a scheme for an international meeting, or assembly, in connection with the 1900 Paris Exhibition. With this object in view a general and advisory committee, consisting of members of the B.A., the French Association, and of other representatives of pure and allied science, education, art, &c., is to be formed for the purpose of promoting the arrangements. Profs. Mavor and Geddes are the acting secretaries, and Mr. T. R. Marr the assistant secretary. The offices are 5, Old Queen Street, Westminster, S.W., and 95, Boulevard St. Michel, Paris.

Appointment.—The Bootle Town Council has appointed Mr. W. R. Wright, of Burnley, as its borough electrical engineer.

Presentation.—Mr. P. B. Steele, manager of the electrical department of Messrs. Shirras, Laing & Co., Limited, Aberdeen, was, on the occasion of his departure from the firm's service, presented with a handsome silver salver.

NEW COMPANIES REGISTERED.

Hiram S. Maxim Automobile Syndicate, Limited (63,846).—This company was registered on October 13th, with a capital of £25,000 in £1 shares, to adopt an agreement with H. S. Maxim and J. de Meray, to acquire certain inventions by Hiram S. Maxim relating to motor carriages and other vehicles, and to carry on the business of motor car, motor cycle, and bicycle manufacturers, engineers, suppliers of electricity and other motive power, and manufacturers of electrical apparatus and machinery of all kinds. The subscribers are:—J. de Meray, 1, Rutland Gate, Hyde Park, 2,000 shares; M. Lachman, Bickenhall Mansions, W., engineer, 2,000 shares; H. W. Rydon, Winchester House, E.C., solicitor, 1 share; A. Grove, J.P., 11, Hans Road, S.W., 2,000 shares; A. C. M. Innes, 22, Ryder Street, S.W., gentleman, 1,000 shares; M. E. Williams, Winchester House, E.C., solicitor, 1,000 shares; The Maxim Electrical Engineering Company, Limited (W. J. Wheatley, secretary and manager), 1,000 shares; and H. S. Maxim, 18, Queen's Gate Place, S.W., civil engineer, 1,000 shares. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; remuneration, 10 per cent. of the net profits divisible.

West of England Electric Installation Company, Limited (63,813).—This company was registered on October 9th, with a capital of £25,000 in £5 shares, to adopt an agreement with the mayor, aldermen, and burgesses of the City of Bristol, and to carry on the business of electricians, electrical and mechanical engineers, fitters, manufacturers of electrical plant, apparatus and machinery, &c. The first subscribers (each with one share) are:—H. C. Hill, Carlton Chambers, Bristol, accountant; E. Davey, Glenfall Lodge, Redland, iron merchant; G. S. Lysaght, Dorset House, Clifton, iron master; F. W. Ball, 3, Unity Street, Bristol, electrical engineer; H. W. Ball, 3, Unity Street, Bristol, electrical engineer; E. S. Stevens, 22, Southfield Road, Cotham, Bristol, electrical engineer; and F. Holman, 44, Queen Charlotte Street, Bristol, corn broker. Registered without articles of association.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

West London and Provincial Electric Supply Company, Limited (62,097).—This company's statutory return was filed on October 11th, when 39,728 preference and 15,305 ordinary shares were taken up out of a nominal capital of £150,000 in 80,000 preference and 70,000 ordinary shares of £1 each. 12s. 6d. has been called up on each of 32,228 preference and 7,805 ordinary. £23,833 2s. 6d. has been received, and £1,187 10s. remains unpaid. 15,000 shares are considered as fully paid.

Barcelona Tramways Company, Limited.—This company's annual return was filed on September 27th, when 26,000 shares were taken up out of a capital of £300,000 in 30,000 shares of £10 each; £260,000 has been received.

CITY NOTES.

Chester Corporation Electricity Accounts.
Public lighting and private supply.

The Chester Corporation is one of those municipal bodies which entered upon electricity supply with some hesitancy, and therefore the accounts for the first of the two years summarised below cannot be detailed under the heading of "costs." The revenue account under "to generation of electricity," contains only one engineering item, owing to the station being farmed out to contractors.

"A. 5. To other items (to be specified).
Contractors for supply of electrical energy from Dec. 20th, 1896, to March 25th, 1898, as per contract £3,188 1s. 5d."

It will be noticed that the gross profit has risen from £3,358 in the total under our heading 1897, to £4,658 in 1898, being an increase of no less than £1,300, against a difference in gross revenue of a much smaller sum, namely, £857, and this notwithstanding a drop in the average price per unit sold of nearly ¾d. It is unnecessary to dwell upon this at length, but like all other cases where timidity or natural caution has led to the farming-out principle being adopted (as an example one at once calls Croydon to mind), the Corporation finds that it can do better with the works in its own hands. This is a lesson which may not be without value to those municipalities which are considering how a start should be made.

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£46,790	£54,772	£7,982
Number of units sold	355,957	473,656	117,699
Total maximum demand... ...	266 kw.	350 kw.	84 kw.
Gross revenue	£6,808	£7,665	£857
Gross profit	£3,358	£4,658	£1,300
Average price per unit sold ...	4·50d.	3·77d.	—·73d.

The revenue statement shows that the meter rents per unit sold remained unaltered, but a slight increase is due to a small item appearing in last year's account for "supply of lamps":—

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£6,680	4·50d.	£7,438	3·77d.	—·73d.
Meter rents	128	·09d.	183	·09d.	...
Supply of lamps	...	...	44	·02d.	+·02d.
Sundry	...	...	...	...	...
Gross revenue ...	£6,808	4·59d.	£7,665	3·88d.	—·71d.

The public lighting at the beginning of the period under review comprises 85 arc lamps. The present number is 116, and 120 incandescents are also in use. The units generated, &c., may be stated thus:—

	Public lamps.	Private supply.	Total sold.	Used on works.	Total generated.
1897 ...	103,311	252,646	355,957	65,522	470,524
1898 ...	147,077	326,579	473,656	71,999	575,131

For the reasons indicated above, the comparison of costs cannot be made on a very definite basis, but attention may be drawn to the low values of the items. Coal at ·3d; oil, waste, &c., at less than ·1d, and wages at less than ¼d., with a total cost of just over 1d. per unit show an extremely creditable state of things.

Costs of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal and other fuel	...	...	£598	·30d.	...
Oil, waste, water and engine room stores.	...	...	163	·09d.	...
Salaries and wages incurred in generation and distribution.	...	...	875	·44d.	...
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	...	...	370	·19d.	...
Works' cost ...	£3,188	2·15d.*	£2,006	1·02d.*	—·80d.*
Rent, rates, and taxes ..	125	·08d.	83	·04d.	— 04d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	...	...	654	·33d.*	...
General establishment charges, stationery and printing, law charges and insurance.	137	·09d.	264	·18d.	+·04d.
Other expenses	...	...	...	...	...
Total costs ...	£3,450	2·32d.	£3,007	1·52d.	—·80d.

* Works' cost, plus management, salaries, taken together in each case in estimating the "increase" (= 2·15d. — 1·35d. = ·80d.).

The profit last year was sufficient to carry over £1,000 to preliminary expenses, while over £800 was put to reserve fund.

Profit Statement.

	1897.	1898.
Interest on loans	£1,612	£1,442
Sinking fund for repayments	732	1,317
Net profit, carried to preliminary expenses	514	1,053
" " reserve fund	500	846
Gross profit	£3,358	£4,658

Brazilian Submarine Telegraph Company.

The directors' report for the half-year ended June 30th, 1899, to be submitted to the general meeting on October 25th at Winchester House at 12 o'clock, reads:—"The directors submit the annexed accounts and balance-sheet for the half-year ended June 30th, 1899. The revenue for this period amounted to £119,360 12s. 2d., and the working expenses to £21,999 3s. 4d. After providing £3,200 5s. for debenture interest and sinking fund, and £1,725 18s. 6d. for income-tax, there remains a balance of £92,435 5s. 4d.; to this is added the sum of £15,801 9s. 4d. brought forward from December 31st last, making a total of £108,236 14s. 8d. Further expenses in connection with closer working union with the Western and Brazilian Telegraph Company, Limited, and the London Platino-Brazilian Telegraph Company, Limited, £635 9s. 5d., and a quarterly interim dividend, amounting to £30,898 19s., have been paid, and £20,000 transferred to the reserve fund. The directors now recommend the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which, together, will amount to £51,639 10s., leaving a balance of £5,062 16s. 3d. to be carried forward. The dividend and bonus will be payable on the 26th inst. Shareholders in the Western and Brazilian Telegraph Company, Limited, have sold to this company about 95 per cent. of the share capital of the former company, steps are being taken to acquire the remaining interest. Notice of an extraordinary general meeting is sent herewith. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., and Messrs. Gane, Jackson, Jeffreys & Wells, offer themselves for re-election."

At the close of this meeting, an extraordinary general meeting will be held to pass certain resolutions approving agreements, issuing certain capital, altering an article of association, and changing the name of the company to the Western Telegraph Company, Limited.

The Western and Brazilian Telegraph Company, Limited.

The directors' report, to be presented at the general meeting to be held at Winchester House on Tuesday, October 24th at 12 o'clock noon, reads:—

"The directors submit their report and the accounts of the company for the half-year ended June 30th, 1899. The total earnings amount to £66,494 8s. 8d., as against £72,692 13s. 10d., showing a decrease of £6,198 5s. 2d. compared with the half-year to June 30th, 1898. The working expenses amount to £45,730 8s., as against £43,179 1s. during the preceding half-year. Including the amount brought forward from December 31st, 1898, and the dividend receivable upon the shares held in the 'Platino' Company, and after providing for income-tax, the balance to the credit of the revenue account is £30,001 3s., from which has been deducted £8,020 2s. 4d. for interest on debentures and debenture stock, and £1,079 10s. has been placed to debenture stock redemption fund, leaving a balance of £20,901 10s. 8d. The directors now recommend the payment of 4s. per share, free of income-tax, for the half-year on the ordinary shares, leaving a balance of £1,421 18s. 8d. to be carried forward. In the case of shares which have been divided into 'preferred' and 'deferred,' the 4s. per share now recommended will be payable, viz, 3s. 9d. per share to the 'preferred' shareholders, and 3d. to the 'deferred' shareholders. The shareholders in this company, representing about 95 per cent. of the capital, having exchanged their shares for shares in the Brazilian Submarine Telegraph Company, Limited, it is now proposed to liquidate the Western and Brazilian Telegraph Company. Notice of an extraordinary general meeting to be held for this purpose is sent herewith. The dividend warrants will be posted on 24th inst."

At the close of the ordinary meeting, an extraordinary general meeting will be held to pass resolutions approving an agreement with the Brazilian Submarine Telegraph Company, winding up voluntarily, and appointing Mr. W. H. Axworthy liquidator.

The Cuba Submarine Telegraph Company, Limited.

The directors' report for the half-year ending June 30th, 1899, to be presented at the general meeting of shareholders on October 25th, at 12 o'clock noon, at 58, Old Broad Street, E.C., reads:—"The directors beg to submit, duly audited, the balance-sheet and accounts for the half-year ended June 30th last. From these it will be seen that the total receipts amount to £25,027 2s. 8d., and the gross expenditure to £7,257 2s. 10d., leaving a sum of £17,769 19s. 10d., which, added to the balance of £4,212 7s. 8d. brought from the last account, leaves £21,982 7s. 6d. at the credit of the revenue account. The traffic receipts show a decrease of £8,738 12s. 10d. as compared with the corresponding period of last year, when they were abnormally large, owing to the Spanish-American war. The

sum of £8,000 has been added to the reserve fund, which now stands at £128,000. The dividend on the preference shares will absorb £3,000, and leave £10,982 7s. 6d., out of which the directors recommend the payment of a dividend at the rate of 6 per cent. per annum, and a bonus of 2s. per share, on the ordinary shares, both free of income-tax, the balance, £4,582 7s. 6d., being carried forward to the current half-year. The cables continued in good working order until the beginning of the current half-year, when the Cienfuegos-Cape Cruz section became interrupted, the Cape Cruz-Manzanillo section has since also given way, and arrangements are now being made for their repair. The directors are in communication with the Foreign Office as to the company's claim for the cost of repairing the cables damaged during the Spanish-American war. The retiring director is Mr. Robert Kaye Gray, who, being eligible, offers himself for re-election. Messrs. Gane, Jackson, Jeffreys & Wells, C.A., the auditors, also retire, and offer themselves for re-election. Annexed hereto is a comparative statement of traffic."

Prospectus.—Until Monday next, 23rd inst., the Barcelona Tramways Company, Limited, is inviting subscriptions for £48,100 4½ per cent. redeemable debenture stock, and £50,000 5 per cent. cumulative preferance capital in £10 shares. Our readers are aware that at the beginning of the year electric traction was inaugurated for a part of the system, and that since then the results of that section have been very satisfactory. The capital now being offered to the public will be applied to paying for and completing the outlay on the conversion of the company's system to electric traction, for providing 40 additional cars, and other purposes. The offices of the company are at Winchester House, E.C., from which forms of application can be obtained.

Montevideo Telephone Company, Limited—The report for the year ended July 31st shows a net profit of £8,227, after providing for working expenses in Montevideo and London and writing off amounts for bad debts, depreciation of stock and materials at Montevideo, and office furniture. To this amount should be added £2,603 brought forward, leaving an available balance of £10,830. The directors proposed to transfer £2,500 to reserve, and recommend a dividend at the rate of 2½ per cent. per annum on the ordinary share capital, £2,258 being carried forward.

Stock Exchange Announcements.—Applications have been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to Metropolitan Electric Supply Company, Limited—£125,000 3½ per cent. mortgage debenture stock; and to allow the following securities to be quoted in the Official List:—United River Plate Telephone Company, Limited—5 per cent. cumulative preference shares of £5 each.

The Indo-European Telegraph Company, Limited.—The board of directors have declared an interim dividend for the half-year ended June 30th last at the rate of 5 per cent. per annum, free of income-tax, payable on and after November 1st next. The transfer books will be closed from October 17th to 31st, both inclusive.

Globe Telegraph and Trust.—The directors announce an interim dividend of 1s. 9d. per share on the ordinary shares.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 14th, 1899, were £349 16s. 1d.; receipts for week ending October 14th, 1898, £894 2s. 0d.; aggregate for half-year to date, £18,308 3s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending October 13th, 1899, were £3,045 2s. 7d.; corresponding period, 1898, £2,664 8s. 7d.; increase, £380 14s. 0d.

The City and South London Railway Company.—The receipts for the week ending October 15th, 1899, were £1,031; week ending October 16th, 1898, £1,002; increase, £29. Total receipts for half-year, 1899, £15,214; total receipts corresponding period, 1898, £15,251, decrease, £37. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending October 14th, 1899, were £200 2s. 7d.; week ending October 15th, 1898, £182 0s. 10d.; increase, £18 1s. 9d. Total receipts to date, 1899, £8,275 4s. 2d.; corresponding period, 1898, £6,800 9s. 6d.; increase, £1,474 14s. 8d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,788, 1898, 4,296. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, October 13th, 1899, were as follows:—D. U. T. Co., horse cars, £1,247 11s. 0d.; ditto, electric cars, £2,154 19s. 7d.; D. S. D. Co., electric cars, £851 9s. 3d.; total, £4,253 19s. 10d.; corresponding week last year—D. U. T. Co., horse cars, £2 644 15s. 9d.; ditto, electric cars, £416 1s. 11d.; D. S. D. Co., electric cars, £908 14s. 4d.; total, £3,969 12s. 0d.; increase, £284 7s. 10d. Aggregate to date, £67,099 13s. 1d.; aggregate to date last year, £65,818 13s. 9d.; increase to date, £1,785 19s. 4d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending October 15th, 1899, were £626. Miles of track open, 12. Car miles run, 29,212. Number of cars, 21. The receipts for the week ending October 19th, 1898, were £222. Increase, £404. Miles of track open, 8½. Car miles run, 8,539. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £17,019; total receipts to date, 1898, from June 29th, 1898, £4,446.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 15th, 1899, amounted to £1,524; corresponding week last year £1,388; increase, £136.

The South Staffordshire Tramways Company.—The receipts for week ending October 13th 1899, were £706 14s. 9d.; aggregate receipts for 41 weeks, £27,971 14s. 10d.; week ending October 14th, 1898, £460 2s. 3d.; aggregate receipts for 41 weeks, £25,921 2s. 9d.

STOCKS AND SHARES.

Wednesday Evening.

Once more a better tone throughout the electrical markets has to be chronicled. Fears of dearer money that were induced by the war scare are daily lessening, as the money market displays its regular surplus of cash awaiting weekly investment at 2 per cent. under the Bank of England minimum. The war itself, now that hostilities are actually begun, has acted as a bull point in every direction, anything being considered better than the horrible suspense which hung over the Stock Exchange a fortnight ago. It is generally considered that a short campaign will suffice for the Boers to feel their stupidity in kicking against the pricks, so that to discount peace is now allowable and prudent. Electrical shares, particularly telegraph descriptions, have, of course, fully shared in the better feeling that is abroad, and after the fall the markets stand on a healthier basis than they did prior to the shake-out. While there will be ups-and-downs before the Transvaal matter is settled once and for all, it would seem probable that the trend of investment stocks is likely to be upwards for the next few months, and another factor that has to be borne in mind is the constantly increasing capital which awaits investment in this country.

Coming to details, the principal feature in the electrical supply section is the dealing that is taking place in the new shares and fractions issued by the St. James's and Pall Mall Company. The whole shares fluctuate between 1⅞ and 2¼ premium, but there are many more sellers than buyers, for the simple reason that shareholders have a rooted objection to odd numbers, and to take the little bonus which a sale brings is more tempting than to buy the extra shares required to make an allotment up to a round number. The same remarks apply with even more strength to dealings in the fractions. Each "thirteenth" is worth about 2s. 9d. premium. A glorious muddle, by the way, has occurred with regard to stamping the renunciation letters issued by the company. Whether it is necessary to attach a 6d. or a 1d. stamp to the document is being fiercely debated, but we may here state that the renunciation of *whole* shares requires a 6d. stamp, but in the case of *fractions*, an ordinary 1d. one is all that is needful.

City of Londons weakened upon a sale of 50 shares by a broker, but immediately hardened when he found that he had made a mistake in his order, and attempted to repurchase them. Countys are ¼ off, but the rest of the market shows no quotable change, with the exception of St. James's shares, to which we have already referred, and which are now ex the rights to the new issue.

As indicated in our introductory remarks, the telegraph department has largely recovered from its war-weakness. Easterns have taken the lead and are 6 points up, reckoning the dividend deducted last Friday. It has at last come to be recognised that war will benefit the company immensely, and its business, for the present at any rate, is not likely to be hampered by the somewhat foolish restrictions now imposed upon customers as regards code facilities. Eastern Extensions are also better, the price being now ex dividend, and in the Anglo-American list both Anglo "B" and Ordinary exhibit an advance upon an idea that the stocks looked cheap after being marked ex. Brazilian Submarines have also improved upon the satisfactory report, but Commercial Cable stock has dropped 2½, despite the vigorous defenders that the company has found against those who drew gloomy forecasts of its future when wireless telegraphy shall come into more general use. Western and Brazilians are soon to vanish from the market altogether, as 95 per cent. of its share capital has now been sold to the Brazilian Submarine.

Railway and traction issues call for little comment. Metropolitan Districts have been rushed up by the clique which took them in hand not long ago, and the old reports about what will happen after the line is electrified are again doing service. Buenos Ayres and Belgrano Tramway shares are now quoted 5⅝, fully paid, and Barcelona Trams continue in the neighbourhood of 14, the City having once more been restored to its normal orderliness. The new issue of capital will, it is thought, strengthen the company's position, but the prospectus should have given more figures with regard to the progress that is being made.

Brush Ordinary are a good market, and have found supporters at 2. Electric Construction, contrariwise, incline to dulness, and there are free sellers at the middle price. Elmores have relapsed, and it is stated that the bright hopes entertained not so very long ago as to the company's near future are not being fulfilled.

Telephone shares are inanimate, and in the Trust division Globes have succeeded in retaining their rise of last week.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Oct. 11th.	Closing Quotation, Oct. 18th.	Business done during week ended Oct. 18th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64	61 — 64 xd	62¾	62
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	112½—113½	112 —113 xd	113½	112½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 14¾	14¼— 14¾	14½	14½
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	14¾— 15¼	15 — 15½	15⅝	14⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —190	180 —190	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	103½	102½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9¾	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½ %	3½ %	11½— 12	11½— 12	11⅝	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	146 —150	149 —154	152½	148½
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102	99 —102	100½	99
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —123	118 —123	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14 — 14½	14 — 14¼xd	14⅜	14⅛
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	117 —122	117 —122	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	102 —106%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5⅛ %	10¾— 11½	10¾— 11½	11⅛	10⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15⅝	15 1/16
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30½	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5 — 5¼	5 — 5¼	5 7/16	5
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5 3/16	5⅛
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	101	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8 xd	7¾	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	127 —132 xd	128	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	100	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	8%	...	1½— 1¾	1½— 1¾	1 7/16	...
84,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10¾	10½— 10¾	10⅝	10 5/16
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	9⅞	...
80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6¼	6 — 6¼	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	8⅛	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	110 —112	110 —112	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	11 1/16	11 1/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13 3/16	13 1/16
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10¾— 11¼	10½— 11	10 13/16	10½
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13¼	13 1/16
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	81 — 84	81 — 84	83½	82½
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 6⅝	6½— 6⅝	6 2/16	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15⅝	15½
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16 — 17	15 — 16	15⅝	15½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 9½	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	4 1/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½—15½	14½— 15½	15½	...

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Oct. 11th.	Closing Quotation Oct. 18th.	Business done during week ended Oct. 18th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	17 — 18	16½— 17½	17½	17⅛
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13⅜— 14¼	13⅜— 14¼	14⅛	13⅞
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128	125 —128	128½	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅜— 2	1⅞— 2⅛	2	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2 5/16	2¼
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	111¾	110¾
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	13½— 14½	13½— 14½	14⅛	13⅞
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10¼	10⅛
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4½— 5	4½— 5	...	..
71,447	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	...	...
630,000£	City and South London Railway	Stock	1 1/16 %	1⅛%	2⅛%	63 — 66	63 — 66	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6⅝	6½— 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3 13/16	3⅝
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	96½	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	3⅜	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	106	105½
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	3/8— 5/8	¼ — ½	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	3½%	3½%	8½— 8⅝	8½— 8⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13½— 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	38⅝	37½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	105	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	100 —103	101 —104	102¼	100

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
British Aluminium, Ordinary, 9—10; 7 % Pref., 9½—10½.
Brompton and Kensington, 4½% Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 1—3.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7⅛—7⅜. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18⅜.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, October 18th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a ,, Nitric .. .. .. per cwt.	22/-	22/-	..
a ,, Oxalic .. .. .. per cwt.	32/-	32/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	35/-	35/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a ,, ,, ... per ton	£23	£23	..
a Bleaching powder .. .. per ton	£6 10	£5 15	15s. inc.
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a ,, (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26	£25 10	10s. inc.
a Lead, Nitrate .. .. .. per ton	£25	£24	20s. inc.
a ,, White Sugar .. .. .. per ton	£31	£31	..
a ,, Peroxide .. .. .. per ton	£37 10	£37 10	..
a Methylated Spirit .. .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks .. per lb.	3½d.	3½d.	..
a ,, Caustic (75/80 %) .. per ton	£24	£24	..
a ,, Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a ,, Recovered .. .. per ton	£5 10	£5 10	..
a ,, Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a ,, Crystals .. .. .. per ton	£3	£3	..
a ,, Bichromate, casks .. per lb.	2¼d.	2¼d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b ,, Sheet, in ton lots .. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 8" to 12") basis per lb.	8½d.	8½d.	..
c ,, Tube (brazed) .. .. per lb.	10¼d.	10¼d.	..
c ,, Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f ,, Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g ,, Wire (basis price) .. per lb.	10½d.	10½d.	..
g ,, Sheet .. .. .. per ton	£88	£88	..
g ,, Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/2½ to 4/5	4/2½ to 4/5	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i ,, Pig (Cleveland warrants) per ton	68/10	68/11	1d. dec.
i ,, Forgings, according to size per ton	From £11	From £11	..
i ,, Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i ,, Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£16 15	£16 10	5s. inc.
g ,, Sheet .. .. per ton	£18 10	£18 10	..
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bottle	£8 17 6	£8 17 6	..
d Mica (in original cases), small per lb.	2d. to 6d.	2d. to 6d.	..
d ,, ,, ,, medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d ,, ,, ,, large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, r'l'd str'p & sheet per lb.	From 1/3½	From 1/3½	..
o Platinum .. .. per oz.	£3 11	£3 10	1s. inc.
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/11	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. par ton	£149	£150 10	30s. dec.
g ,, foil .. .. per lb.	1/9	1/9	..
n ,, wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundle) pr lb.	7¾d.	7¾d.	..
j ,, Best Flax, 6 lea. .. per lb.	4¾d.	4¾d.	..
j ,, Hemp, 8 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j ,, ,, Russian, 10 lbs. per lb.	4½d.	4½d.	..
j ,, Jute, 180 lbs. rove .. per ton	£13 10	£13	10s. inc.
k Zinc, Sheet (Vielle Montague bnd.) p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

ELECTRICAL UNDERTAKINGS IN RUSSIA.

In an article in the *Western Electrician*, Chicago, the present position of the electrical industry in Russia is dealt with as follows:—

The electrical industry in Russia in the form of stock companies is chiefly a creation of foreign, especially German, capital, and of a quite recent date. Only 10 years ago Russia had but one electric stock company, the Electric Lighting Company of St. Petersburg and Moscow, formed in 1888. All the others have come into existence during the last five years. At the end of 1898 the number of companies amounted to 20, five of which were purely foreign companies, while the rest of them, in name at least, figured as Russian concerns. In the latter class is the Electric Lighting Company, which was formed with a large share of German capital by the firm of Siemens and Halske, of Berlin. In 1896 the declared stock of the company, valued at 4,100,000 rubles, was exclusively subscribed for in Germany. (A ruble is valued at about 52 cents in American money.)

In 1894 the firm of Sawitzki & Strauss, of Kieff, was converted into a stock company with a capital of £450,000 rubles. The company supplies the cities of Kieff and Poltava with electric light, and furnishes power for industrial purposes. During the first three years of the company's existence dividends of 8 per cent., 1 per cent., and 6 per cent. were paid, while in the last two years no dividend was paid. In the same year, 1894, the Russian Company for the Utilisation of Electric Power (capital 500,000 rubles) was formed. This company did not begin active operations until some years later, and the result of these operations was not a financial success.

Then followed in 1895 the Electric Company M. M. Podobsdow. At first this company seemed to develop favourably; for the first year a dividend of 4 per cent. was realised, and the stock was for a time the object of keen speculation on the St. Petersburg Bourse. Then a perceptible reaction took place, and at present the company is in an embarrassed position. In 1896 the Electricity Company was formed at Warsaw (capital 1,200,000 rubles) by bankers and manufacturers of Warsaw. It has so far been successful, although no dividends have been paid as yet. Then came the Russian Electric Railway and Lighting Company, formerly R. v. Hartmann & Co. (capital 1,000,000 rubles). This company was formed for the purpose of operating the electric railway at Nischni-Novgorod, at the Great Pan-Russian Fair of 1896. Its first year of existence closed with a considerable loss.

Mention should also be made of the following-named companies, which have never been in operation or only during the last year, so that no account of their business can as yet be given: Russian Electro-mechanic Company (capital 4,500,000 rubles), the principal object of which is to build and operate locomotives and electric railways on Jean Jacques Heilmann's system, the stock being chiefly in the hands of Frenchmen; Russian Accumulator Works, Tudor, with a capital of 600,000 rubles; Northern Electric Company (capital 1,200,000 rubles), for the electric lighting of the suburb, Wassili-Ostrow, near St. Petersburg; the Wuxen Company (capital 5,250,000 rubles), for the utilisation of the waterfalls of the River Wuoxen for electric power, and in which a good deal of foreign capital is represented, a large shareholder being the firm of Brown, Boveri & Co., of Baden, Switzerland; the St. Petersburg Company for the Utilisation of Water-Power for Electric Purposes (capital 6,000,000 rubles), for utilising the power of the waterfalls near Narva and of the Imatra. Then come the Siemens & Halske Russian Electro-technical Works (capital 4,000,000 rubles), and the Russian Electric Company Union (capital 6,000,000 rubles), both of which are chiefly dependent on German capital.

Of the foreign companies operating in Russia three are Belgian, viz., Compagnie Centrale d'Electricité á Moscou Eclairage de St. Petersbourg and Compagnie de Traction et d'Electricité; two are German companies, the Helios Electric Company, of Cologne, and the General Electric Company, of St. Petersburg. Of these companies, the first-named supplies the city of Rostov-on-Don and Jekaterinburg in Southern Russia with electric light; it has been very successful, clearing 82,522 francs in 1896-97, from a capital of 1,500,000 francs, and 109,588 francs in 1897-98. The Compagnie de Traction et d'Electricité has a half interest in the street railways of Tula, Kronstadt, Reval, Vilna, Minsk, Woronesch and Samara. St. Petersburg is the principal field of operation of the other three companies. They supply electric power chiefly for lighting and industrial purposes.

It should also be mentioned that several of the numerous Belgian street railway companies, strictly speaking, belong to this classification, as some of the newer ones not only build electric street railways, but also furnish electric light and electric power.

Thus, it is evident that everything of any importance in the electric industry owes its existence to foreign capital and foreign enterprise. The domestic companies have not succeeded in any respect and are of no importance. The combination formed lately in Berlin for electric enterprises in Russia will probably still more strengthen and increase this state of affairs. Of the above-mentioned firms the following named are members of this newly formed syndicate: Electric Lighting Company, Siemens & Halske and the Union. Taking the influence and financial power of the International Commercial Bank of St. Petersburg into consideration, there is little doubt that the new combination will occupy a prominent position among the electrical industries of Russia. The syndicate has a capital of 20,000,000 rubles. The board of directors consists of seven members. The headquarters are at St. Petersburg, and the banking house of Rothschild Frères, of Paris, is also represented. The Société d'Etudes Russes, of Paris, and the Franco-Russian Electric Company, of Geneva, Switzerland, are also interested in the syndicate.

The imports of all kinds of electrical machinery into Russia are steadily increasing. The latest available statistics on the total importation are those for the year 1897, when the imports of dynamo-electric machinery alone amounted in value to 1,733,000 rubles, as against 1,214,000 in the previous year. About two-thirds of this trade is in the hands of German manufacturers.

ELECTRIC LIGHTING PROVISIONAL ORDERS.

The following is the form of provisional order under the Electric Lighting Acts, 1882 and 1888, to which reference was made in our "Notes" last week:—

PROVISIONAL ORDER
(SESSION .)

PROVISIONAL ORDER

GRANTED BY THE BOARD OF TRADE UNDER THE ELECTRIC LIGHTING ACTS, 1882 AND 1888* TO (*name of Undertakers*)

IN RESPECT OF (*name of borough or district in which the area of supply is situated*).

1. This Order may be cited as the Electric Lighting Order, 19 .	Short title.
2. The provisions contained in the Schedule to the Electric Lighting (Clauses) Act, 1899 (with the exception of Sections 83 and 84 of that Schedule†), are incorporated with and form part of this Order.	Incorporation of the Electric Lighting (Clauses) Act, 1899.
3. The Undertakers for the purposes of this Order and within the meaning of Section 2 of the Schedule to the Electric Lighting (Clauses) Act, 1899, are the‡	Undertakers.
4. The area of supply for the purposes of this Order and within the meaning of Section 4 of the Schedule to the Electric Lighting (Clauses) Act, 1899, shall be the area which is described in the First Schedule to this Order, and is more particularly delineated on the map deposited together with this Order at the Board of Trade by the Undertakers, and signed by an assistant secretary to the Board of Trade.	Area of supply.
5.§ Subject to the provisions incorporated with this Order, the Undertakers are specially authorised by this Order to break up streets not repairable by the local authority which are mentioned in the Second Schedule to this Order, and the railways and tramways which are also mentioned in that Schedule.	Power to break up streets, &c.
6. The streets and parts of streets throughout which the Undertakers are to lay down suitable and sufficient distributing mains for the purpose of general supply within a period of two years after the commencement of this Order, as mentioned in Section 21 of the Schedule to the Electric Lighting (Clauses) Act, 1899, are those mentioned in the Third Schedule to this Order.	Compulsory works.
7. The maximum prices which may be charged by the Undertakers as mentioned in Section 32 of the Schedule to the Electric Lighting (Clauses) Act, 1899, are those stated in the Fourth Schedule to this Order.	Maximum prices.
8‖. The sum to be deposited or secured in pursuance of Section 5 of the Schedule to the Electric Lighting (Clauses) Act, 1899, is pounds.	Deposit.
9. This Order shall come into force upon the day when the Act confirming this Order is passed, and that day, for the purposes of the Electric Lighting (Clauses) Act, 1899, shall be the commencement of this Order.	Commencement of Order.

[N.B.—Where an Order is granted to a Company or person having overhead wires already installed, a clause will be inserted providing for their removal, except in special circumstances.]

FIRST SCHEDULE.

¶ Area of supply—

SECOND SCHEDULE.

List of streets not repairable by the local authority, railways, and tramways which may be broken up by the Undertakers in pursuance of the special powers granted by this Order.

(*a*) Streets:

(*b*) ** Railways:

(*c*) Tramways

THIRD SCHEDULE.

List of streets and parts of streets throughout which the Undertakers are to lay down suitable and sufficient distributing mains for the purposes of general supply, within a period of two years after the commencement of this Order—

* In Scotch Orders add "and the Electric Lighting (Scotland) Act, 1890."

† In Scotch Orders Section 84 only, in Irish Orders Section 83 only must be excepted.

‡ A company registered under the Companies Acts should be so described, and the address of the registered office should be added.

§ *See* Section 12 of the Schedule to the Electric Lighting (Clauses) Act, 1899.

‖ This provision is not required in the case of an Order granted to a local authority.

¶ Where the area of supply consists wholly of recognised areas of government, such as boroughs, districts, or parishes, it will be described accordingly. In other cases detailed boundaries must be inserted, and a provision added, that in the case of difference between the description in the Schedule and the area as delineated on the deposited map, the latter is to prevail.

** In ordinary cases the level crossings must be specified: In the case of a light railway or other railway running along the highway on the level, the length and position of the railway must be described.

FOURTH SCHEDULE.

Maximum Prices.

In this schedule—

The expression "unit" shall mean the energy contained in a current of 1,000 amperes flowing under an electromotive force of 1 volt during one hour.

Section 1.

Where the Undertakers charge any consumer by the actual amount of energy supplied to him, they shall be entitled to charge him at the following rates per quarter:—For any amount up to 20 units, 13s. 4d.; for each unit over 20 units, 8d.

Section 2.

Where the Undertakers charge any consumer by the electrical quantity contained in the supply given to him, they shall be entitled to charge him according to the rates set forth in Section 1 of this schedule, the amount of energy supplied to him being taken to be the product of that electrical quantity and the declared pressure at the consumer's terminals, that is to say, such a constant pressure at those terminals as may be declared by the Undertakers under the Board of Trade regulations.

SOME ELECTRIC STREET RAILWAY DATA.*

By HARRIS J. RYAN,
Professor of Electrical Engineering, Cornell University.

During the spring of 1899, copies of a question form for gathering statistical data relating to the construction and operation of electric street railway plants were sent to the managements of some of the plants in our country with the request that they be filled in with the requisite data and returned to the writer. In this request it was stated that average results of the replies would be published. Replies were received from 12 plants that were fairly complete. The data from eight of these plants have been averaged as far as possible. The results form the composite answers to the questions in the form as given below, which was originally sent to the management of each plant.

Whenever percentages appear in an answer they mean that the answer applies to plants aggregating in capacity those percentages of the total average daily kilowatt output for the eight plants.

Buildings.

Size of complete power house, 319 feet × 574 feet; 183,500 square feet. Engine and dynamo room, 240 feet × 440 feet; 105,000 square feet. Boiler room, &c., 188 feet × 440 feet; 82,900 square feet.

Constructive materials:—

Foundations: 37·0 per cent. masonry; 23·2 per cent. concrete; 29·2 per cent. concrete and stone masonry; 6 per cent. brick in cement; 4·6 per cent. not reported.

Walls: 76·8 per cent. brick; 12·2 per cent. pressed brick front; enamelled and pressed brick in engine room; 11·0 per cent. steel structure filled with brick.

Roof: 12·2 per cent. tile with tar and felt; 11 per cent. matched pine on steel structure; 20·5 per cent. composition tar roof; 6 per cent. wood asphalted; 4·6 per cent. wood; 10·5 per cent. slate, steel trusses; 16·5 per cent. slate over engine room, corrugated iron over boiler room; 18·7 per cent. slate on pine sheathing supported on steel trusses and purlins.

Floor: 18·7 per cent. vitrified tile laid on concrete arches and supported on steel I-beams; 16·5 per cent. concrete; 10·5 per cent. wood in engine room, cement in boiler rooms; 23·2 per cent. mill construction, hard wood finish; 24·5 per cent. wood; 6 per cent. wood covered with steel plate.

Car barns: 76·8 per cent., 444,645 square feet; 21 per cent. no report.

Repair shops: 78·9 per cent., 83,722 square feet; 21·1 per cent., no report.

Cost of power house, building only, no reports.

Power House Equipment, Mechanical.

Engines:—Total number of engines, 46.

Types of engines: 1 (125 H.P.) high speed; 4 (2,100 H.P.) Porter and Allen; 16 (12,200 H.P.) American-Wheelock; 1 (1,200 H.P.) Green-Wheelock compound condensing; 12 (9,250 H.P.) "Corliss" or "simple Corliss"; 3 (1,200 H.P.) simple Corliss condensing; 5 (3,650 H.P.) Corliss compound condensing; 4 (2,400 H.P.) Providence-Green tandem compound condensing.

Average rated H.P. of each, 700; aggregate rated H.P., 32,125.

Condensing, 8,450 H.P.; non-condensing, 23,675 H.P.

Cost of engines erected, including foundations: Simple non-condensing, 15,550 H.P.; cost $14·88 per H.P.

Tandem compound condensing, 2,400 H.P.; cost $29·66 per H.P.

Number of spare units, 14; total I.H.P., 9,250.

Boilers: Total number of boilers, 106; steam pressure, 100 to 125 lbs.

Rated power:—

Fire-tube boilers, 19—3,800 H.P.	100 lbs.
Fire-tube boilers, 19—3,800	110 "
Fire-tube boilers, 24—7,200 H.P.	115 "
Fire-tube boilers, 6—750 H.P.	120 "
Water-tube boilers 6—2,250 H.P.	100 "
Water-tube boilers 7—2,650 H.P.	120 "
Water-tube boilers 23—5,950 H.P.	125 "
Total fire-tube boilers 65—14,150 H.P. ...	100 lbs. to 120 "
Total water-tube boilers 36—10,850 H.P.	100 lbs. to 125 "
Total Cahill vertical boilers 5—1,250 H.P.	120 "

Aggregate capacity of boilers, 26,250 H.P.

Number of spare units, 24; capacity, 6,725 H.P.

Steam fitting and appliances:—

System of steam piping: 89·5 per cent. single; 10·5 per cent. double.

Natural draught: 100 per cent. use.

Forced draught: 89·5 per cent. do not use; 10·5 per cent. use.

Hand firing: 58·1 per cent. use.

Mechanical stokers: 41·9 per cent. use.

Coal conveyors: 29·7 per cent. use.

Ash conveyors: 46·2 per cent. use.

Economisers: 15·6 per cent. use.

Cost: 11 per cent. fire-tube boilers with natural draught, mechanical stokers, coal and ash conveyors, installed about 1897, cost $19·75 per rated H.P.

Summary:—

Cost of steam plant, including engines, boilers, piping, and all auxiliary apparatus, erected and ready for operation: 17,950 H.P.; total cost, $316,514, or $45.50 per rated H.P.; varying from $29.10 to $56.90, according to date of installation and nature of equipment.

Power House Equipment, Electrical.

Generators:—

Total number of generators, 54; aggregate capacity. 25,930 KW; 17 generators, direct driven, 11,000 KW.; 21 generators, belt driven, 4,530 KW.; 16 generators, rope driven, 10,400 KW.

Average daily load, 9,608 KW.; maximum, 14,437 KW.; minimum, 5,981 KW.

Number of spare units, 17; capacity, 7,090 KW.

Cost of generators, including foundations, &c.:—

8—4,600 KW.—direct connected, cost $23 per KW.

16—10,400 KW.—belted, cost $13 per KW.

Switchboard:—

Number of generator panels, 59; feeder panels, 131.

Cost of switchboard erected, including necessary apparatus, &c.:—

1. Generator panels: No report.
2. Feeder panels: 16·5 per cent, $1.65.
3. Total: 23·2 per cent., $3,600.
4. Per KW.: 23·2 per cent. 3·46.

Recording instruments, 64·4 per cent. use.

Wattmeters, 84·9 per cent. use.

Summary.—

Cost of electrical equipment, including generators, switchboards, wiring, &c., erected ready for operation: 15,050 KW., cost $18.95 per KW.

Grand summary:—

Cost of completed station and all contents: Excluding land, 15,050 KW., cost $75.25 per KW.

Road and Equipment.

Track:—

Mileage: 58·4 per cent. have 213 miles of road and 335 miles of track; 25·1 per cent. 138 miles of track, single or unspecified; 16·5 per cent. not reported.

Rails: 18·7 per cent. 60 feet, 90 lbs. girder; a few 60 feet, and others 30 feet girder and T, ranging in weight from 35 to 107 lbs.

Track foundation: 23·2 per cent. dirt mostly, ballasted to some extent with crushed stone; 25·5 per cent. macadam; 4·6 per cent. slag; 10·5 per cent. earth, ashes, broken stone, concrete; 18·7 per cent. 90 lbs. 60 feet girder rails with broken limestone ballast 6 inches deep under cross ties.

Bonds: A variety, generally copper rods riveted; vary in size from No. 4 to two No. 000 B. & S. per rail joint.

Supplementary wires: 23·2 per cent. have 35 per cent. in excess of feeder copper.

Ties: 6 × 8 inches × 7 feet average; mostly oak (a few chestnut) spaced 24 inches c. to c. In one instance steel ties 1⅜ × 7 inches × 5 feet 6 inches, spaced 10 feet apart and laid in concrete were used.

Paving: Depends entirely on local conditions.

	Per mile of track. Single.	Double.
Cost of all material used	$6,800	$13,600
Cost of all labour required to instal	3,080	6,160
Cost of paving, labour and material	6,200	12,400
Total cost of road-bed, complete	$16,080	$32,160

This is the average report for 42 per cent. part earth and part broken stone ballast, 7-inch girder rails, cast weld joints, no bonds.

Overhead construction:—

Span wire or bracket construction: 67 per cent. span wire; 16·5 per cent. span wire and bracket; 16·5 per cent., no report.

Size of trolley wire: 83·5 per cent. No. 0 B. & S. hard drawn copper, except about 5 per cent. of this where No. 00 is used; 16 per cent., no report.

Poles: 39·2 per cent. iron pipe, spaced 100 feet to 110 feet; 29·2 per cent. steel and wood, spaced 115 feet to 120 feet; 4·6 per cent. cedar, spaced 110 feet; 10·5 per cent. chestnut, spaced 100 feet.

Feeders: 22·5 per cent. have 45 feeders, aggregating 1,066,400 feet; 23·2 per cent. have 125 feeders, aggregating 1,900,000 lbs., including insulation.

	Per mile of track. Single.	Double.
Cost of all material, overhead construction ...	$2,325	$2,826
Cost of all labour for erection	213	427
Total cost of overhead construction ...	$2,538	$3,253

* Paper read at the New York Street Railway Convention.

The above is for iron poles. For wooden poles, material one-third and labour one-half the above.

Equipment:—

Number of motor cars: Closed, 1,197; open, 1,008; convertible, 75. Total, 2,280. These figures reported for 83·5 per cent.

Average daily number of cars in use: 83·5 per cent, 908.

Average daily mileage per car: 79·9 per cent., 122·4 miles.

Total car-miles per day, 58·4 per cent., 57,862.

Length of car bodies:—

	Closed.	Open.
18·7 per cent.	20 ft.	30 ft.
10·5 „	16 ft., 18 ft., 28 ft.	27 ft., 30 ft.
4·6 „	18 ft.	28 ft.
6·0 „	16 ft., 18 ft.	18 ft., 21 ft.
20·5 „	28 ft.	22 ft.
23·2 „	21 ft.	28 ft.

Cost of car bodies: Closed, 20 feet, $900 to $1,200; open, 30 feet to 32 feet, $600 to $800.

Cost of trucks: Single, $175 to $250; double and maximum traction, $315 to $425.

Type of motors: G. E. 800, Walker No. 5, Westinghouse Nos. 3, 12A, 49O.

Number of motors per car: Two, except for a few 28 feet cars on which four motors are used.

Rated power of motors: 25 to 50 H.P. each.

Cost of motors and appliances per car, installed: $700 to $1,000, according to size of motors.

Summary:—

Total cost of motor car, including car body, truck, motors, and all appliances installed ready for operation:—

1. Closed motor car, average, $1,700 to $2,500.
2. Open motor car, average, $1,400 to $2,070.
3. Convertible motor car, average, $2,375.

Roads built between 1892 and 1898, average.

Operating Expenses.

Kind of fuel and cost delivered:—

23·2 per cent. Indiana screening, at $1.07 to $1.25 per ton.

20·5 per cent. soft coal.

6·0 per cent. bituminous, at $3.60 per ton, and slack at $2.35 per ton.

10·5 per cent. anthracite bird's eye and buckwheat at $ 4.62½.

18·7 per cent. bituminous slack, at $.60 to $.70.

Kilowatt-hours per day: 49·7 per cent., 79.480.

Cost of Power per kw.-hour.

Average report for 42 per cent:—

Operation: Fuel	$ 0060
Water	·0001
Labour	·0027
Repairs	·00053
Total, without interest or depreciation	$ 00933

Cost of Operation per Car-mile.

Average report for 42 per cent., cars of medium size:—

Power			$ 01015
Maintenance of equipment:—			
Trucks	$ 00285		
Motors	·00502		
Car bodies	·00669		
		Total ...	·01456
Maintenance of way			·01000
Motormen, conductors, inspection, &c....			05968
General expenses, salaries, &c.			·0386
Taxes, insurance, legal expenses, damage, miscellaneous, &c.			·01681
Grand total			$ 11506

AN ATTEMPTED TWO-CYCLE GAS ENGINE.

A new gas engine is suggested by Mr. F. H. Smith and illustrated in *Feilden's Magazine*. The new engine has two pistons in one cylinder. One piston is attached as usual to the rod, the other being free and carrying a spring on its front face. The inlet port is forward in the cylinder and just open when the piston is at full outward position As the main piston travels back it closes this port and compresses the air and gas imprisoned between the two pistons and forces them through a valve in the free piston and into the back of the cylinder. When the main piston moves out the valve automatically closes, and the main piston is of course followed by the free piston by virtue of the vacuum that would otherwise be formed in any intermediate space, and in spite of the opposing force of the now compressed spring. The two pistons thus travel out together until the port is opened again when the spring reacts and draws in the fresh charge of gas and air, the free piston going back to the end of the cylinder under pressure from the spring. Thus there is a charge every revolution, and the only seriously weak feature is the coiled spring. It is essential that this spring should be strong so as to drive the free piston quickly backwards, and whether practical difficulties will prevent ultimate success cannot be said without further experience. But the idea is admirable.

It is claimed that the free piston is an automatic governor, for if the engine ran beyond normal speed the amount of fresh charge drawn in would be reduced because the attached piston would follow up the free piston more quickly than this latter could complete its full back movement. This certainly appears feasible, the action being controlled by movement of the inlet cock, whereby the opening can be made more or less free, and the piston movement can be regulated accordingly. There is something remarkably ingenious about this new engine. We believe it to be perfectly novel, and the combination is very curious, and yet simple. The weak point appears to be the spring between the two pistons. This spring is called on to work through a large range of movement, and will be put to great mechanical stress. But given the endurance of this, or an equivalent in shape of an air cushion, and there is no apparent reason why the engine should not work, and work well.

The free piston in combination with the ordinary piston accomplishes what has been attempted by means of a separate cylinder, as in the Clerk engine. It will be observed that the action of the free piston takes effect after the main piston has passed the inlet port at the forward end of the cylinder, and only then after the exhaust valve is opened so as to remove the pressure from the back of the free piston. This done, the spring begins to act, it pushes back the free piston and draws in the fresh charge between the two pistons, the main piston still moving forward slowly at or near the dead point. The action of the spring must be such as to push the free piston completely back in the space of time occupied by the main piston in travelling from the point where it first opened the edge of the inlet valve to the time of its re-covering same on the return stroke. Clearly any slower action of the free piston will curtail the volume filled by the fresh charge, and the engine will run slower until the full charge is admitted. Hence arises the claim that the speed of the engine is controlled by the free piston, and should the spring become weak the first result would be that the engine would run slower.

The free piston thus forms a sort of inertia governor. A numerical example will assist to give clearer ideas as to the spring. Let the stroke of a 6-inch piston be 6 inches, and the speed of revolution 300 per minute or 5 per second. Then the back movement of the free piston must be performed in a certain fraction of $\frac{1}{5}$th of a second. This fraction of a revolution is represented by an arc of crank movement which we will assume to be 30° on each side of the dead point or a total arc of $\frac{1}{12}$th of the circle. This represents $\frac{1}{60}$th of a second. In this time the free piston must move 6 inches, and as it starts from zero of velocity — we will neglect its inertia or momentum which is negative—it must attain a velocity of 1 foot per second during its movement of 6 inches in order that it may cover 6 inches in the time. Obviously, therefore, the spring must give an acceleration of 1 foot per $\frac{1}{30}$th of a second in $\frac{1}{30}$th of a second. Gravity gives an acceleration of approximately the same rate or 30 feet per second, but requires 1 second to do it in. In other words, assuming gravity = 30, for simplicity, a body moves under its influence in $\frac{1}{30}$th of a second a distance represented by the formula, $s = t^2 \times \frac{g}{2}$; in this case, t being $\frac{1}{30}$th, we have $s = \frac{1}{900} \times 15 = \frac{1}{60}$th of a foot, or $\frac{1}{10}$th of the desired amount of 6 inches. The piston spring must therefore be 30 times the equivalent of gravity. In other words, the spring must have a resilience of 30 lbs. for each pound weight of the free piston. Assume this free piston to average only 1 inch in thickness. Its area is approximately $6^2 \times .7854 = 28$ square inches, so that its weight would be 7 lbs, and the spring must exert an average force of $7 \times 30 = 210$ lbs. The spring pressure is thus $210 \div 28 =$ nearly 8 lbs. per square inch of piston area, which is about 7 lbs. less than vacuum effect, so that with tight fitting pistons capable of producing a good vacuum between themselves there will be a surplus pressure to hold the pistons together on the forward stroke of, say, 5 lbs., in addition to the excess of working pressure behind the piston. These figures, if correct, point to the problem being easy of solution in all respects except the spring, and in the case assumed a 210-lb. spring with a range of 6 inches will be something of a problem to solve, while the substitution of an air cylinder for the spring would rob the cylinder space of something of its charge capacity and unduly reduce the engine power. But in all this let it not be forgotten that the power of the engine is being doubled for equal dimensions, and anything to be subtracted will only mean so much less than doubling. Given a successful spring the idea points to a very substantial increase in the power to be obtained from a given size of engine.

THE UNSPEAKABLE TROLLEY.

Englishmen are prone to consider the French somewhat unpractical, but in doing so we venture to think they are somewhat mistaken. In many ways the French have distinctly distanced not only ourselves, but other nations, in the very lines along which we and others have prided ourselves as being first. We do not here allude simply to scientific matters, though in these the French are well to the front, for what nation has produced a more brilliant array of chemists or physicists than the French? We would refer more immediately to practical affairs. As a city, Paris has no equal; yet the excitable French remain perfectly calm at the sight of trains of half a dozen long tramcars coupled together and running through their streets. Such trains are a common sight in Paris. One may travel on them from the Louvre to Versailles, passing along city streets and suburban roads equally without danger. The motive power is steam. In England the mention of a steam tramway raises a picture of a short puffing ash box, smelling of oil and grease, dirty and unkempt as a London and Chatham locomotive. But in France the steam

tramway engine is a clean affair. It is difficult to see where the boiler and machinery are placed, so little are they apparent. At various points in the city single large Serpollet tramcars may be seen running of equally clean and sightly description, and, in a word, our neighbours appear to have solved steam traction far better than we have done. On the same lines and of very similar appearance are the accumulator cars. We do not know much of the figures of maintenance, but the cars appear to run well and to be generally satisfactory.

In overhead electrical traction again, the French are not horrified by the presence of the poles or the trolley wires. All over Rouen, a city of large size, and far superior to any of our provincial cities in appearance and cleanliness, the overhead system is extensive and is by no means conspicuous. Now, all these things are within reach of our municipal authorities. Probably they have all been seen by such authorities, though at the expense of long-suffering ratepayers, and there has been no excuse for delay. If the worthy mayors and aldermen who have joined in Continental excursions out of the rates had properly used their eyes they would not so long have stopped the way. Apart, however, from mayors and aldermen, we fear that much harm is done by those who advise them, and who, with an array of facts before them, seem bent, each one, upon some fantastic idea of his own, in place of striving to utilise standard plans and worked-out ideas. We refer to the consulting engineers, many of whom, without an ounce of traction experience, set themselves to advise corporate bodies whom they so confuse by condemning sound proposals in order to foist their own crude ideas on their clients, that practically they stop genuine progress. Overhead work in America is often very rough and crude as compared with recognised standards here. Should we not, therefore, in face of the performances of such rough material there, be satisfied to extend our own better class of work, and trust to the future for improved methods, as these are pointed out by experience?

In the craze for ornament we are very much of opinion that systems of side bracket poles that might be made very little noticeable, are being brought into prominence by an excess of spandrel ornament. Nor do we understand why local authorities are so enamoured of side bracket poles. Span wire construction is far better for both the streets and the public. It is safer and less conspicuous, yet the clumsier bracket appears to have enamoured the local men to an extraordinary degree. A redundancy of pole ornament is meretricious, and does not speak well for the artistic sentiment of the people who countenance it, nor is it very creditable to 25 years of South Kensington operations upon the people. Why, we would also ask, is an electric tramway company compelled to employ eyesweet poles and costly arms and trimmings, when along the same roads the Government and the Telephone Company are permitted, with never a word of expostulation, to erect crooked, black, creosoted, knotty and weather-split poles with a dozen square off-springing cross-arms and irregularly placed and unsymmetrical insulators with 20 wires or more? Not a word is said against the combined ugliness of these systems, and all denunciation is hurled against the two wires of the tramway and the neat poles. The worst feature of a tramway is the miscalled guard wiring, an exploded fallacy that would have been scrapped long ago if our Board of Trade had kept itself up-to-date.

PROF. LUNGE, OF ZURICH, ON THE FUTURE OF WATER-POWER AND ELECTROLYTIC ALKALI PROCESSES.

By JOHN B. C. KERSHAW, F.I.C.

It was the writer's privilege on Wednesday evening, October 4th, to form one of the very large audience assembled in the chemical theatre of University College, Liverpool, to hear a lecture from Prof. Lunge, of the Zürich Polytechnic, on the above subject. The occasion was the delivery of the first of the annual lectures which the Liverpool Section of the Society of Chemical Industry have planned in memory of the late Dr. F. Hurter, for many years one of its most active members. The title chosen by Prof. Lunge for his lecture, "Impending Changes in the Development of Industry," and the fame of the lecturer, who is recognised as the first authority on chemical technology in Europe, combined to attract a very large attendance of members of the Society and their friends, and more than one of Prof. Lunge's hearers had travelled from London in order to be present on the occasion. Some portion of Prof. Lunge's lecture naturally related to his personal and other relations with the late Dr. Hurter, but with these remarks the writer does not intend to deal, since to most readers of the Electrical Review Dr. Hurter was personally unknown.

The references made by the lecturer to the new method of manufacturing sulphuric acid by the direct union of sulphurous acid gas and oxygen in the presence of platinum black—one of the reactions known as "catalytic"—are also outside of the province of this journal.

But the greater portion of Prof. Lunge's lecture was devoted to a consideration of the changes now being brought about by the utilisation of water-power for industrial purposes in various parts of the world, and to the especial use of the power so obtained for chemical manufactures. These are subjects of the highest interest and importance to electricians, and therefore no excuse is needed for bringing the views of such a high authority as Prof. Lunge upon the present and future prospects of these new developments, under the notice of readers of this paper.

With regard to the general aspect of the subject, the lecturer stated his opinion that the gradual change from coal to water, as a source of power in Europe, was inevitable, and that such change would involve some displacement of the centres of industry. The industrial activity of man upon this earth might be divided into three periods. During the first of these, wood had served as his only source of heat or power. That period had lasted some thousand of years, and had only ended with the dawn of the present century. During the second period coal had been used, and was still being used, to provide heat and power for all industrial purposes.

Those nations which had possessed extensive and easily worked coal-fields, and the requisite mental energy to make use of them, had undergone wonderful expansion during this epoch of industrial history, and to their coal-fields such nations were undoubtedly indebted for their present wealth and importance. But this period must inevitably close, for every year was leading to the depletion of the coal beds of Europe at an increasingly rapid rate, and a point must soon be reached when these coal fields would be exhausted. The wasteful and unscientific use of this form of fuel had also tended to hasten the arrival of the day when Europe would have to turn to China or America for supplies of fuel. The coal epoch in Europe, when it had closed, would be seen to have been short compared with the thousands of years which had preceded it; and when the complete industrial history of mankind came to be written at some long distant date, it would probably be described as a mere short intervening link between two lengthy epochs—the one of wood and the other of water—as sources of power.

In countries deficient in natural water-powers, such as England and Germany, manufacturers ought to devote all their attention, at present, to devices and inventions for obtaining more efficient utilisation of the energy stored in their fuel. Gas producers would probably be used on an increasing scale, and the lecturer had recently examined a new form of producer (the Dellwik) which yielded 82 per cent. of the energy of the fuel in the gas. The use of peat and brown coal, on a scientific basis, would probably be greatly extended, and the evil days in front of manufacturers in the two leading industrial countries of Europe, would be postponed in this manner as long as possible. Mental and physical energy, inventive ability, and business knowledge, which were all on the side of the older countries, would undoubtedly count for something in the struggle for survival, and the decline of manufacturing supremacy would therefore be gradual, and might be long postponed.

With regard to the present position of water-power in Switzerland, it had been proved that at the point of generation, power could be produced at a cost of about £1 per H.P.-year. The area over which this power could be transmitted by means of high tension currents was at present limited to about 60 miles radius; beyond this limit the capital expenditure upon conductors, and transmission losses, caused the cost of the H.P.-year to equal, or exceed, that of steam-power, which in the lowlands of Switzerland cost £11 to £12 per H.P.-year.

Prof. Lunge then proceeded to point out that the present limit of successful competition with steam-power might soon be subject to wide extension, and that developments in power transmission without wire or conductors, or in the cheap production of some form of energy carrier, of which calcium carbide was a type, might enable Switzerland to provide all Europe with power from her melting snows.

In this portion of Prof. Lunge's lecture there is little to criticise, with the exception of his reference to the relative cost of water- and steam-power. It may be perfectly true that at the point of generation, the H.P.-year in Switzerland costs only £1, but at the point of utilisation, the cost in many cases is more than four times this amount; and the writer can

state, as an absolute fact, that the H.P.-year generated by water-power is costing more at Zürich, and more at Rheinfelden, than it would cost if generated from coal under the most favourable conditions in South Lancashire. The figures upon which this statement is based will shortly be published.

Under these relative conditions of cost, it is not quite plain why certain industries should migrate from this country to Switzerland, and the decline of England, as a manufacturing country, when it does occur, will hardly be due to this cause.

The remainder of Prof. Lunge's lecture dealt with the utilisation of water and steam-power for specific electro-chemical and electro-metallurgical industries, and figures were given which represented the prospective production of chemical and other products, when all the factories now building in Europe and America are complete.

The figures presented by Prof. Lunge were based on those recently published by Dr. Borchers (*Zeits. f. Elektrochemie*, July 20th, 1899), and a few of the totals are given below:—

TABLE I.—ESTIMATED PRODUCTION IN 1899.

Product.	Amount in tons.	Largest producing country.	Amount in tons.
Potassium chlorate	10,600	France.	6,300
Caustic potash	17,280	Germany.	17,280
Caustic soda	82,560	France.	45,280
Bleaching powder	225,000	France.	99,050
Calc. carbide	254,000	France.	35,000
		U. States.	60,000
Carborundum	1,025	France.	800

TABLE II.—WATER AND STEAM-POWER AVAILABLE FOR ELECTRO-CHEMICAL MANUFACTURES IN 1899.

Country.	Water-power.	Steam-power.
	H.P.	H.P.
Austria	27,000	...
France	110,000	1,300
Germany	13 800	16,173
United Kingdom	11 500	8,150
Italy	29,400	...
Norway	31,500	...
Russia	6,000	1,500
Spain	7,100	...
Sweden	29,000	...
Switzerland	38,900	...
United States	72,300	11,750
Canada	1,500	...
Belgium	...	1,000
Transvaal	...	454
Total	378,000	...

Prof. Lunge disclaimed responsibility for these figures, and pointed out that some of them, notably those relating to the production of alkali and bleaching powder in France, were certainly inaccurate. The writer has paid considerable attention to the industrial side of electro-chemistry, and he also is convinced that most of these estimates of Dr. Borchers are much in excess of the present production; and he would suggest that they be used with considerable caution. Possibly they are meant to be prophetic, rather than actual, in character, and relate to the year 1901.

At the conclusion of his lecture, Prof. Lunge stated his opinion that the world's consumption of alkali will, in the future, be provided by the ammonic-soda, and by the electrolytic works, that the latter will *alone* provide the world's requirements of bleaching powder and other chlorine products, and that the manufacture of the lower strengths of sulphuric acid will be carried out by the old Le Blanc process. The writer is inclined to agree with Prof. Lunge in this forecast of the future; but he is not so ready as the lecturer to assume that this change in the methods of manufacture *must inevitably* cause the transfer of the chemical industry from South Lancashire to the valleys of France and Switzerland, or to the fiords of Norway. If the Castner-Kellner Electrolytic Alkali Works at Runcorn can manufacture electrolytic bleach and alkali by use of steam-power, and can continue to earn 8 per cent. dividends for its shareholders, the days of the alkali industry are not yet numbered, so far as this country is concerned. But fresh capital will have to be invested in the industry if it is to reap all the advantages offered by these new processes of manufacture; and unfortunately there would seem to be a much greater readiness at the present moment to invest capital in the promotion of chemical undertakings abroad than of those at home. The discussion of the causes of this unsatisfactory condition of affairs would be of interest, but it is outside the scope of the present article, which has for its purpose simply the presentation and discussion of the chief points of Prof. Lunge's most interesting and instructive lecture. The full report of the lecture will appear in the October issue of the *Journal of the Society of Chemical Industry*.

PUMPS FOR CENTRAL STATIONS.

BY E. K. SCOTT.

Steam Pumps.—The ordinary duplex steam pump, until recently the most commonly used in central stations, has been found to be very wasteful of steam because the expansion property is not utilised, and also because the length of stroke is so very uncertain. It may be as much as a couple of inches shorter than full stroke, and as live steam has to be admitted into this clearance there is naturally considerable loss in economy. The Weir vertical single steam pump, of which particulars are given in the table, appears to have overcome many of the objections of the duplex pump, in that it uses the steam expansively, has shorter ports, fewer working parts, and a very much lower number of strokes suffice to pump the same volume of water, thus giving less wear and tear.

COMPARISON OF PUMPS TO DEAL WITH 4,600 GALLONS OF WATER PER HOUR.

Description.	Diameter of water piston.	Length of stroke.	Steam admitted.	Strokes per minute.	Floor space.
Horizontal duplex steam pump.	4	6 in.	Full stroke.	140 each plunger.	5½ ft. × 2 ft.
Vertical Weir single cylinder pump.	8	18 in.	¾ cut-off.	24	2½ ft. square.

Although this is a great improvement, there appears to be a general consensus of opinion in favour of putting down electrically-driven pumps either as a stand-by against the steam pumps, or else to undertake all the pumping of the station.

Electric Pumps for Boiler Feeding.—Broadly speaking, there are two kinds of pumping operations required in a central station:—(1) To supply the boiler feed, and (2) to keep an overhead tank full of water. We will consider each case separately. For boiler feeding the pump is practically always running, the head remains constant, but the delivery is continually varied; therefore, if a ram or piston pump is used, either the number of strokes or the length of stroke must be capable of being varied. The speed of the motor, *i.e.*, the number of strokes, can be adjusted by means of resistances in the field and armature circuits, but the variation thus given is limited, besides being wasteful and reducing the torque of the motor. There are various ways in which the desired object may be attained:—

(*a*) The motor armature may have two separate windings and two commutators arranged with a series parallel controller, so that when the windings are in series the speed is just half what it is when in parallel, the variations being obtained by resistances.

(*b*) By arranging a movable mass of iron in the magnetic circuit, so that the reluctance can be increased or decreased, or by moving the field magnet coils so as to make them more or less effective.

(*c*) By arranging the pump with a bye-pass, as is sometimes done in elevator work.

(*d*) By means of two sets of first motion gear wheels fitted with a clutch, so that the ratio between the motor spindle and the pump crankshaft may be doubled; or by

using one or other of the various patent speed reduction gears.

(*e*) The pump may be driven through cone pulleys by a shifting belt driving in the ordinary way, or by being compressed between the cones.

(*f*) The pump rods may be fitted with adjustable links, so that whilst the throw of the crank remains constant, the stroke of the ram or piston is variable.

Of these methods the first by means of double commutator motor and series parallel control is being most used, and although the double-wound motor and the switch gear are expensive, taking it all round, it makes the best arrangement.

Centrifugal Pumps.—In the second case, in which a tank has to be kept filled, the pump is generally started and stopped by a float switch, but when running it works at full power. For this kind of work the electrically-driven centrifugal pump should find considerable favour because, being a high-speed machine, it can be direct coupled. The pump itself has a lower efficiency than the piston or the ram type, but as gearing is dispensed with the total efficiency of the combination is very little, if any, lower. It is, of course, much cheaper than the three-throw ram pump and motor, its up-keep is less, and it also occupies less floor space.

It is interesting to note that the application of the induction motor to pumping is rather more awkward than is the application of a continuous current motor. For one thing the speed control is difficult, and when the motor is applied to a centrifugal pump, as often as not the critical speed of the motor (governed by its periodicity) does not agree with the critical speed of the pump (governed by its internal construction). The theory of the centrifugal pump is a complicated problem, on which the writer does not propose to enter, but we know that for reasons of convenience and cheapness of manufacture, &c., the pumps are made in certain standard sizes, and it is found from test that for certain pressures and delivery each size has its critical speed. If the speed is reduced the pump fails to deliver against the necessary head or pressure, whilst if the speed be increased there is a drop in pressure due to internal friction, &c., and the power taken by the motor increases at a rate out of all proportion to the useful work being done.

Where the speeds are a good deal out, and the importance of the job will not run to a specially designed pump, then it is necessary to connect the motor and the pump by gearing or belt.

For high speeds belting must be used, but it should be made endless, as small induction motors work with a very small clearance, and a badly made belt joint may thus spring the shaft and cause the rotor and stator to touch.

REVIEWS.

Leçons sur l'Electricite, professées a l'Institut Electrotechnique Montefiore annexé à l'Université de Liège. Par ERIC GERARD, directeur de cet Institut. Tome premier; sixiéme edition. Paris: Gauthiers-Villars et fils.

The new edition of the first volume of this well-known work is a handsome library octavo of 820 pages. It deals with the elementary theory of electricity and magnetism, the general theory and practice of electrical measurement, and the construction of dynamo-electric machinery. The work is extremely well illustrated and well printed. The treatment is not intended for the use of advanced students, and the ground covered is far too extensive to admit of minute discussion of the important points. But the book is well calculated to attract and interest a technical student, while the statements of exact theory are sufficient for the educational purpose aimed at. French and Belgian students are very fortunate in the style in which their text-books are issued.

Gas and Electric Lighting Works' Directory and Statistics. 1899. London: Hazell, Watson & Viney, Limited.

The title of this directory might more truly be rendered: "A Gas Works' Directory, with a Few Pages Regarding Electricity Works," for that is really what it is. The book cannot be classed among those which it is imperative that the electrical engineer should have upon his shelves, unless for the purpose of learning what a splendid future there lies in store for electricity in the establishment of electricity works in all the towns and villages, &c., which now own or contain gasworks. It may be a useful book from this point of view, as a guide to the electrical promoter where next to centre his attentions. Electricity works, although so well represented in the title, are favoured with 38 pages right at the end of the book, the chapter being headed "Directory and Statistics of Electric Lighting Work," and the compiler is not to be congratulated upon the accuracy of some of the information. We will quote just one or two errors which a casual glance over a few pages has disclosed. The Hammersmith works' capital outlay is given as £42,000, whereas it is somewhere approaching double that sum. The Kingswood electricity system, about which everybody has heard, appears in the list, although the very exciting way in which the works were closed, and came under the hammer early in the year, ought to be well known, as well as the fact that gas lighting is now in vogue there. The Bootle Corporation is stated to be proceeding to carry out its electric lighting powers, but we may inform the compiler that the works actually commenced supplying current in April. At the foot of too many sets of general details are words denoting that "no return has been received." This is a difficulty under which every statistician suffers, and it detracts from any electrical value that the work may otherwise possess. There is a general index of officials, and the arrangement and binding of the book are very good, but as a directory of electricity works it is not so useful as it might be. As a gas works' directory it may be all right. Perhaps we may further add that September was rather a late date for the publication of a directory for the current year.

Cours de Physique de l'Ecole Poletechnique. Par M. J. JAMIN. Deuxiéme Supplément par M. BOUTY. Progrés de l'Electricité (Oscillations Hertziennes—Rayons Cathodiques et Rayons X.). Paris: Gauthiers-Villars.

Jamin's "Cours de Physique" is probably, of foreign scientific manuals, the most widely read in England. The new volume, uniform in size and style with the others, deals with the recent developments in electricity, and this mode of bringing the book up-to-date is certainly very convenient. Of the principal chapters, one treats of new instruments and new measurements of electrical quantities; another of the passage of electricity through electrolytes, another of Hertz waves, another of cathode and X rays. It need not be said that the treatment of the subject by M. Bouty is clear and scholarly. It appears to be fully equal to the rest of the series to which it is appended.

The Construction of Cranes and Lifting Machinery. By E. C. R. MARKS. Manchester: The Technical Publishing Company. 1899. 3s. 6d. net.

This is one of the Technical Publishing Company's little manuals, and gives good dimensioned descriptions of a considerable number and variety of types of lifting tackle, including pulley blocks, crabs, hand cranes, derricks, car lifts, jacks, and capstans, and many others, with a couple of chapters on electric cranes. Lifting tackle is not much understood, as a rule, by most engineers, and this book will be found useful in designing such machinery. As the author truly says, a subject of such magnitude cannot be treated within the narrow limits of a small volume, and only more prominent examples have been selected; but the work has been done well, and we can cordially recommend the book to young engineers.

Problems of Machine Design. By CHAS. H. INNES, M.A. Second edition. Manchester: The Technical Publishing Company. 1899.

With slight exception, this book might have been entitled "Problems in Steam Engine Mechanism," for it deals chiefly with the design of parts of the steam engine—governors, shafts, piston and connecting rods, valve gears, &c., and fly-wheels. The section on valve gears is deduced almost

entirely from the methods of Zeuner, whose graphic system is employed on both simple valves and the more complicated movements of double valves of the Meyer type.

The illustrations are good and clear, and in view of the recent *Bullfinch* disaster, figs. 57 and 58, illustrative of marine connecting rods, are rather noticeable, though the author makes no comment on the weak form of fork.

The chapter on boiler riveting is excellent, the finding of the percentage strength of a joint being well explained.

The chapter on shafting will be found interesting in connection with the recent arguments anent the Glasgow engines, for a table of examples is given, and shows as much as 10,600 I.H.P. through a 20¼-inch shaft at 89 revolutions and 10,350 I.H.P. through a 25-inch shaft at 53 revolutions per minute, the boiler pressures being 150 lbs. and 90 lbs. respectively, and the stroke 69 inches and 78 inches for L.P. cylinders 113 inches and 2—100 inches. The examples are from the mercantile marine, and, of course, for screw engines.

For hollow shafting, it appears that the British navy allows 3,000 I.H.P. to pass through a 16-inch shaft with an 8-inch hole through it at 95 revolutions, and Uncle Sam allows 6,750 I.H.P. in the same shaft with, however, only a 7½-inch hole at 129 revolutions. For 5,000 I.H.P. at 164 revolutions, Uncle Sam bores a 6-inch hole out of a 13½-inch shaft, and at almost the same speed—165·3. Her Majesty cuts out 5¾ inches from a shaft of 11½ inches for 4,000 I.H.P. Obviously, the naval practice of the two nations practically coincides. Our author makes a good point on the question of the bending stress on an overhung shaft. The lever arm of the bending moment is commonly taken from the centre of the neck, but this cannot be correct, for, as the author states, it is obviously absurd to suppose that lengthening the journal will increase this overhang stress. But it is important to maintain a proper contact of the brasses right up to the extremities of a bearing. Indeed, for long bearings it would appear to us to be good practice to use two of half the length each, there being a distinct central gap.

Engine balancing is fully gone into, perhaps with too much elaboration of mathematical formulæ.

We should have liked more on shaft or fly-wheel governors, only two being illustrated, and nothing said of the inertia action which adds so much to the rapidity of action of a governor under sudden variation of load.

A final chapter is given to the drawing of diagrams for compound engines. We are glad to recommend this little book to students and young draughtsmen.

Dissected Model of a Direct Current Dynamo. By ARNOLD PHILIP, A.I.E.E., B.Sc. George Philip & Son, 1899.

The essential part of this production is, in the author's words, "a dynamo constructed of paper, which can be opened out and its internal anatomy observed." It must be conceded that this is an accurate description. The model consists of a series of coloured plates, partly profiled, and carefully superposed; the outermost represents a complete four-pole dynamo in elevation (orthographic projection); raising this, the reverse shows the machine bereft of its field magnets, while the next plate shows it with the pulley and commutator bars removed. The back of this plate is a compilation of anatomical details, penetrating as far as the naked shaft; when raised it reveals the armature in position in a sectional view of the frame, while the winding can be lifted off, exposing the armature core in *section*. The plates are full of surprises, and remind us of our childhood's days, when "magical books" were in vogue; every little detail is shown, and its relations with adjacent parts made clear. We are not sure that the type of dynamo chosen is the best for the purpose; it resembles the Lahmeyer designs in some respects, but is quite unlike any modern English machine with which we are acquainted.

The model is prefaced by a lucid explanation, which begins with a sort of family tree tracing various forms of energy back to the sun as the ultimate source; this is followed by a condensed treatment of the theory of magnetism, leading up to its application to the construction of dynamos. Armature winding is more fully dealt with in an appendix. An additional cross-sectional view, at right angles to the shaft, would be an improvement; it is difficult to picture the actual machine from views showing two dimensions only.

The work is intended "for the use of general readers and students," and is essentially of the "popular" description; we believe that the principle upon which it is based is of great value, and that *where actual machines are inaccessible* it will go far to fill the want of them.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

19,710. "Improvements in wireless telegraphy." S. G. BROWN. Dated October 2nd.

19,758. "Improvements in electric telephony." A. B. MACGREGOR. Dated October 2nd.

19,781. "Improvements in or relating to electrical switches." S. A. HUNTER. Dated October 2nd.

19,785. "Electro-chemical process for cleaning metal surfaces." THE VEREINIGTE ELECTRICITATS-ACTIENGESELLSCHAFT and J. KLAUDY. Dated October 3rd.

19,787. "Improvements in means for electrically igniting miners' safety lamps." W. BEST. Dated October 3rd.

19,793. "Improvements in or relating to the electro-plating and burnishing of certain articles, and in apparatus to be used therein." B. J. ROUND and A. ROUND. Dated October 3rd.

19,818. "Improvements in the construction of wicks for oil lamps which are electrically lighted." R. O. BEST. Dated October 3rd.

19,825. "Improvements for rendering moulds conducting in the electrolytic bath." H. J. SHELDON. Dated October 3rd.

19,846. "A new and improved conduit terminal and junction box for electric wires." R. M. THOMAS. Dated October 3rd. (Complete.)

19,849. "Means or apparatus for recording the electrical vibrations or undulations known as Hertzian waves." W. FRIESE-GREENE. Dated October 3rd.

19,854. "Improvements in electric railways and tramways on the surface contact system." (Post-dated (April 21st, 1899) and renumbered 19,854, under Sec. 7, Patents, &c., Acts, 1883—1888). P. PINCKNEY. Dated October 3rd.

19,856. "Improvements in magnetic separators." W. CLARK. (C. F. Courtney, New South Wales.) Dated October 3rd.

19,863. "Improvements in or connected with telephonic apparatus." W. GRAY. Dated October 3rd. (Complete.)

19,867. "Improvements in or connected with telegraphic apparatus." A. C. CREHORE and G. O. SQUIER. Dated October 3rd.

19,916. "An improved safety connecting bar or hanger for overhead electric wires carrying strong currents." W. P. THOMPSON. (The firm of Petsch and Gürtler, Austria.) Dated October 4th.

19,939. "An electrolytic method for drilling and slotting metals." S. O. COWPER-COLES. Dated October 5th.

19,941. "Improvements in certain electric tramcars." W. H. PICK. Dated October 5th.

19,943. "Improvements in 'trolleys' for electric tramcars." C. K. EVERITT. Dated October 5th.

20,002. "Improvements in electric motors." A. HEYLAND. Dated October 5th. (Complete.)

20,045. "An improved sliding electric light." W. HOOLEY. Dated October 6th.

20,068. "An improved ohmmeter or apparatus for directly indicating resistances." C. BEEZ. Dated October 6th. (Complete.)

20,084. "Improvements in the method of and means for transmitting and receiving electric waves for the production of signals and for imparting motion to machines or apparatus." J. CERVERA-BAVIERA. Dated October 6th. (Complete.)

20,110. "Improvements in electrical accumulators." F. LOPPE, H. P. MORIN, D. P. MARTIN, and G. J. A. GRINER. Dated October 6th. (Date applied for under Patents, &c., Act, 1883, Section 103, April 1st, 1899, being date of application in France.)

20,114. "Improvements in electrophone apparatus." L. E. WILSON. Dated October 6th.

20,121. "Process and apparatus for the production of insulators for electric wires." F. KAPPENBERGER. Dated October 6th. (Complete.)

20,129. "Improvements in the method of lubricating the bearings of commutators of alternate current dynamos." C. B. CRAWSHAW and J. W. LONGLEY. Dated October 7th.

20,130. "Improvements in motor-starting and regulating switches." C. B. CRAWSHAW, H. A. JONES, and J. W. LONGLEY. Dated October 7th.

20,145. "The improved combination electric light fittings." W. SEVENOAKS. Dated October 7th.

20,153. "Improvements in electrical resistances." T. E. GAMBRELL and C. T. GAMBRELL. Dated October 7th.

20,154. "Improvements in or connected with the controllers of electric tramcars or electrically-driven vehicles, machinery, or the like." G. L. ANDREWS. Dated October 7th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

525. **"Improvements in electric signalling."** **S. P. Thompson.** Dated January 7th, 1898. Relates to signalling by means of periodic currents in tuned circuits. The provisional specification refers to signalling on all classes of circuits and lines, but the complete specification only describes methods of signalling in which a magnetic field of predetermined frequency acts inductively on a distant field tuned to the same frequency by means of capacities and self-induction to coils. A generator of predetermined frequency is connected

through a transmitting key with one coil of a transformer. The second coil of the transformer is connected to a coil through tuning condensers and self-induction coils, and may be provided with a spark-gap. At the receiving station a coil and tuning devices are connected to a similarly-tuned receiver or relay. Various forms of receivers are described, including a coil oscillating in a tuned field, a needle or armature suspended by a tuned torsion wire, &c. One form of receiver, having a three-phase rotating field acting on a suspended coil, is described for use with a two-contact key and double-wound opposing generator. 4 claims.

533. "Improvements in electric arc lamps." A. J. Hills. Dated January 8th, 1898. Relates to arc lamps. In a lamp having two or more arcs in series, the upper carbons are carried by rods which slide in a cast-iron casing and are controlled by clutch-washers in engagement with a single forked link; this is hung from a horizontal regulating lever, supported at one end by an upright, and linked at the other to the armature of a series electro-magnet. The movements of this armature are controlled by a dash-pot. In the lamp shown, a second electro-magnet is in series with the carbons, and normally holds up an armature lever from a contact spring: when the current is sufficiently reduced by the lengthening of the arcs, the lever makes contact with the spring, short-circuiting the main electro-magnet, which then allows the upper carbons to drop. This mechanism may be dispensed with. The length of each arc may be further controlled by a wire connected in parallel with the arc, and arranged so that its thermal expansion or contraction raises or lowers one of the carbon holders. 1 claim.

591. "Improvements in telephone transmitters." A. Graham. Dated January 8th, 1898. Microphones. Microphones are constructed so as to be waterproof and to be capable of resisting shocks when used in exposed positions such as on ships, by divers, &c. The disc is of vulcanite fibre, and carries in a recess a carbon cup with a backing of paper, felt, &c. A carbon and a metal diaphragm closes the front of the carbon cup and has its edges preferably soldered to a metal ring. Carbon dust or granules is enclosed in the carbon cup by a felt, &c., ring. A protective perforated sheet is set in the mouthpiece. The joints are all made good by solder, shellac, or other suitable means. 1 claim.

735. "Improvements in switches for use in electric light installations." H. Taffs and J. Hill. Dated January 11th, 1898. Electric switches. Relates to a quick-break switch particularly adapted for u e with lamps. A base having perforations at right angles is fitted with spring plunger contacts and with a grooved sliding block of insulating material on which is a conducting ring. On pushing in the block at one end contact is made; on pushing the other end, contact is quickly broken by the plungers springing into the groove. 2 claims.

831. "A system of conducting electricity for propelling, heating, lighting and telephoning from railway vehicles." H. W. Libbey. Dated January 11th, 1898. Electric railways. Relates to a system of conductors and means of connecting such conductors to the apparatus on railway vehicles for propelling, lighting, and heating such vehicles, and telephoning from such vehicles to any point or station. The main insulated T-shaped conductor is supported in a fork which is surmounted by a plunger attached to a take-off T-shaped conductor arranged in insulated sections. The plunger is supported by a soft rubber cylinder faced above and below with hard rubber washers. The wheel is provided with a groove in its flange and has a conducting ring shrunk on to insulation. A collecting roller is mounted on the bogie truck, and is connected to a switch from which parallel branches go to various circuits with their necessary apparatus. Instead of the two leads being arranged on separate wheels, the flange of one wheel may have two insulated collecting rings acting on two main leads close together. 4 claims.

835. "Improvements in single-phase and multiphase alternate current motors." L. B. Atkinson. Dated January 11th, 1898. Electric motors. Relates to monophase alternating current motors, and is in part an extension of the invention described in Specification No. 15,714, A.D. 1895. Instead of short-circuiting the armature relatively to the inducing axis and producing a cross field for starting purposes by means of auxiliary pole-pieces wound in series with the inducing or field coils, the armature is connected in series with the auxiliary winding, and thus itself provides the necessary cross field. Sparking at the brushes may be prevented by so proportioning the fields that the electromotive force due to the movement of the short-circuited coil in the inducing field is balanced by the induced electromotive force due to the cross field. One device for preventing sparking consists in winding the armature with two independent circuits connected to alternate collector sections, and using divided brushes with separate connecting circuits so as to prevent short-circuiting of the coils under the brush. The motor may be regulated by using an auto-transformer from which any desired fraction of the line pressure can be obtained, or by means of a regulating transformer having a variable coefficient of mutual induction. Or a closed coil inducing winding may be used, and the points of connection of the supply circuit varied so as to vary the direction of the inducing axis relatively to the short-circuiting brushes and to regulate the electromotive force induced in the armature windings. One motor has an inducing or main field produced as before by coils in series with the armature, and a "compensating" field produced by coils supplied like those of the main field from the mains but exerting no inductive effect on the armature and being in phase a quarter period behind the phase of the supply electromotive force. After the motor has been started by one of the above methods, it may be run as an ordinary monophase motor, by short-circuiting the coils in groups through slip rings or otherwise, or it may have an independent winding on the armature adapted for connection to the source of supply, the starting winding being used to excite the field magnets so that the motor runs synchronously. To minimise magnetic leakage, the inducing and induced circuits are made as far as possible geometrically coincident. When the winding of the armature is of the ordinary or diametral type, the inducing winding should be either a two-path distributed winding or a spiral non-crossing distributed winding as described in the specification quoted above. Similarly an inducing winding through one or two holes surrounding the pole face requires a chord winding on the armature. 12 claims.

848. "An improved galvanic battery." J. von der Poppenburg. Dated January 11th, 1898. Galvanic batteries. Relates to both primary and secondary batteries. A primary battery consists of a vessel in the lower part of which is placed a layer of calcium sulphate, to which may be added a chlorate in which may be embedded a metal plate. On the layer is placed a hollow carbon electrode in the interior of which is placed a depolarising substance such as potassium sulphate or bi-sulphate, and this substance is prevented from coming into contact with the layer by an insulating cover of asphalt. A porous ring of felt or the like surrounds the carbon electrode, and on this ring is placed a zinc or like electrode. Around the electrode is placed a quantity of an exciting substance, such as ammonium chloride, and the vessel is closed by a sealed cover in which is a funnel for the admission of water to dissolve the exciting substance. The battery is stated to be regenerative. The same form of battery may be used as a secondary battery, in which case the layer consists of spongy lead, the packing consists of lead oxide or manganic oxide, the cover is dispensed with, and the exciting liquid is dilute sulphuric acid. 3 claims.

933. "Improvements in electrolytical condensers and electric current devices." C. Pollak. Dated January 12th, 1898. Electric condensers, &c. Relates to condensers or current rectifiers consisting of electrolytical cells, such as described in Specifications No. 1,069, A.D. 1896, and No. 23,442, A.D. 1897. The electrodes, one of which should preferably be of aluminium, are immersed in an alkaline solution containing potassium bichromate or like chrome compound. In cases where a quick change is not required, soap solution may be used instead of that above mentioned. 1 claim.

1,002. "Improvements in electricity measuring instruments." A. A. Voysey and R. P. Wilson. Dated January 13th, 1898. Electricity measuring. An electrostatic or other voltmeter is used also for measuring current supplied on alternating-current mains, by connecting it with the secondary of an air-core or other transformer, the primary winding of which carries the current to be measured. Switches for changing the connections, and two pointers and scales are provided for pressure and current measurements.

1,011. "Improvements in holders or sockets for electric incandescent lamps." R. J. Bott. Dated January 13th, 1898. Electric lamps.—Relates to holders for incandescent lamps. A holder for a bayonet-capped lamp consists, in the form shown, of a casing and a flanged insulator connected by a screwed ring, and carrying a detached sleeve provided with diagonal slots, into which the pins on a lamp cap can be inserted in one movement. The sleeve is attached to the casing by a tension spring, held by cross-pins, which engage the insulator and prevent rotation of the sleeve thereon. The lamp terminals bear on contact pieces fixed in the insulator by screws which also hold the conducting wires. The spring allows the sleeve to move away from the body of the holder when a lamp is inserted. In a modification the spring is held compressed in a recess in the insulator by a cross-pin carried by lugs extending from the sleeve within the holder. 3 claims.

1,046. "An improved method and electro-magnetic cut-out for automatically disconnecting charged conductors in the event of breakage or short circuit, applicable to overhead systems of electric traction and the like." R. C. Cain. Dated January 14th, 1898. Relates to means for automatically disconnecting charged conductors, such as overhead wires in traction systems in case of breakage, short-circuit, &c. A series coil is in the conductor and a shunt coil is connected to the extremity of the conductor. These coils control a rocking lever fitted with a support for the weighted switch levers. If the conductor breaks no current flows through the shunt coil, and the lever rocks, opening the switch; similarly the switch is opened with an excess current through the coil. The latter may be replaced by a fuse. A pivoted lever carries an armature at each end, and is fitted with a support for a rod connecting the weighted arms which, when released, operates the switch contact lever, both being pivoted at the same place. A spring tends to pull over the lever. In normal working this is prevented by the shunt coil. 5 claims.

1,140. "Improvements in electro-magnets for electric traction." H. H. Leigh. (The Gesellschaft zur Verwerthung Elektrischer und Magnetischer Stromkraft, Germany.) Dated January 14th, 1898. Relates to electro-magnets for use either in actuating the switches which successively energise sections of the working conductor of an electric railway or tramline, or for use in connection with the rails as a magnetic brake. The magnet consists of a central bolt supporting flanged iron bobbins wound alternately with opposing coils so as to form poles of successively opposite polarity. End blocks having ribs sliding in the grooves of the rails may be provided, and a powerful braking action on the rail is effected by the approach of the pole-pieces when the circuit of the electro-magnet is closed. 2 claims.

1,301. "Electric signalling apparatus." F. B. Herzog. Dated January 17th, 1898. Signalling. Relates to an electric signalling or annunciator apparatus, the indications of which are produced by the electrolysis of a suitable solution, such as iodide of potassium. The solution is placed in a tank which is made of insulating material and closed in front by a removable transparent plate and washer held in place by screws. The tank is enclosed in an outer casing, and the bottom is perforated to receive the rubber plugs through which platinum wires pass from the terminals to the platinum electrodes. The supporting-plates of the terminals may be embedded in an insulating-backing of cement, &c. The terminals are connected to push-buttons, &c., at the different sub-stations, one or more of the terminals serving as a common return for all the circuits. When a signal is transmitted, the solution is electrolysed, and a brown deposit of iodine is formed on the corresponding electrode. Each electrode may be surrounded by a glass cup to catch and retain the deposit, which under ordinary conditions gradually disappears. The deposit may be rendered more permanent by the addition of glycerine, &c, to the solution. Hyposulphite of sodium may also be added to retain the solution in its normal condition. The deposit may be dispersed after each signal by blowing air through the perforated tube, or by reversing the current. A bell may also be included in a common circuit when desired. 21 claims.

1,535. "Improvements in incandescence electric lamps and processes for the production thereof." Dr. C. A. Ritter von Welsbach. Dated January 19th, 1898. Electric lamps. Relates to incandescent lamps. Filaments are made of osmium, or alloys of this with ruthenium, rhodium, or other platinum metals, or these metals alone, and may be coated with oxides, preferably of thorium or zirconium. They are mounted in bulbs which are exhausted or contain reducing gases, and under these circumstances may be heated to extremely high temperatures, so as to emit a large proportion of lighting rays. An osmium filament may be made by coating a wire of platinum, or other metal having a high melting point, by warming it electrically in an atmosphere containing a volatile osmium compound and a suitable reducing gas, such as a mixture of hydrocarbons and water vapour drawn from the middle of a Bunsen flame; the wire is afterwards slowly heated more highly to consolidate the osmium coating, and finally until the platinum has evaporated, leaving a coherent tubular filament of osmium, which may contain a little platinum. The osmium coating may otherwise be deposited by electrolysis, or by repeatedly painting the wire with a solution containing osmium, preferably made into a paste with finely divided metallic osmium or an osmium compound, and a binding material. The filaments are mounted on leading-in wires with such paste, and may be repaired with it; they may be flashed with osmium in the mixture of gases referred to. According to another method, a filament is made by saturating or coating twisted vegetable fibre with an osmium compound, and afterwards burning off the carbonaceous material in gas containing steam and hydrogen or carbon monoxide, but no free oxygen. Or collodion containing an osmium compound may be squirted, denitrated, and decarbonised. Coatings of oxides are produced by applying solutions of nitrate or other salts, and heating; platinum wires so coated may be used at very high temperatures. The provisional specification mentions that the repeated coating operations may be performed by a motor. 17 claims.

1899.

8,820. "Improvements in electric signals or indicators." A. W. Staveley and J. H. Parsons. Dated April 27th, 1899. Relates to drop signals. Consists in the use of a non-magnetic extension-piece clipped or riveted to an iron-plate, and forming holes to receive the poles of an electro-magnet. 4 claims.

8,857. "A new or improved quicksilver electric current interrupter." G. Hirschmann. Dated April 27th, 1899. The mercury vein causing the contact is interrupted at intervals by a rotating disc provided with recesses for the purpose of regulating the number of the current interruptions by the number of these recesses and the speed of rotation of the disc. 3 claims.

9,420. "Improvements in electrical arc lamps." J. Rosemayer. Dated May 4th, 1899. Consists in downwardly extending tubes from the upper chamber having openings at their lower ends or of a downwardly extending casing forming a lower annular opening, so as to allow the gases and air within free outlet, but to restrict the outer air from entering. 2 claims.

9,511. "Method of controlling several rotary phase current motors in an electrical railway train from one point of the train." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated May 5th, 1899. The regulation of the turning moment on starting is effected by providing at the driver's platform a suitable apparatus by which the voltage for working all the motors in the train is varied according to requirement which a resistance that is not subject to variations is included in the induced part of the motor. 1 claim.

9,987. "An improved binding post or device for connecting electrical apparatus." H. H. Lake. (A. R. Shattuck, United States.) Dated May 11th, 1899. Comprises a tubular cylinder of conducting material having one end closed, an enclosing cylinder of non-conducting waterproof material closed at one end and receiving and secured to the other cylinder the conducting wire extending through the non-conducting to the conducting cylinder and the insulating waterproof coating of said wire forming an impervious joint with the non-conducting cylinder. 2 claims.

10,317. "Improved electro-plating process and apparatus therefor." E. L. Dessolle. Dated May 16th, 1899. The process consists of (1) cleaning the article to be plated; (2) touching it up; (3) cleaning it by means of a sand blast; (4) preliminary plating in an alkaline or neutral bath; (5) stopping and filling up surface irregularities; (6) second plating in an alkaline bath; (7) final plating in an acid bath. The anode is double for the purpose of evenly coating the article. 4 claims.